THE RESEARCH NEEDS OF THE CLEAN WATER ACT

HEARINGS

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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[*] On assignment to Budget Committee for 97th Congress.

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THE RESEARCH NEEDS OF THE CLEAN WATER ACT

TUESDAY, JUNE 8, 1982

House of Representatives,
Committee on Science and Technology,
Subcommittee on Natural Resources,
Agriculture Research and Environment,
Washington, D.C.

The subcommittee met, pursuant to call, at 9:50 a.m., in room 2212, Rayburn House Office Building, Hon. James H. Scheuer (chairman of the subcommittee) presiding.

Mr. Scheuer. Good morning. I am Congressman Jim Scheuer.

Today the Subcommittee on Natural Resources, Agriculture Research and Environment will consider the research needs necessary for the full and successful implementation of the Clean Water Act of 1977.

Two primary goals of the Clean Water Act are to make the water of the United States fishable and swimmable by 1983, and to prohibit discharge of pollutants into navigable waters by 1985.

Although we have seen significant improvement in many areas of water pollution, contamination of our waters by toxic chemicals continues to be a very serious problem. It is hoped that the recommendations received from our distinguished witnesses during these hearings will provide us with a valuable record on the immediate- and long-term research that needs to be done to improve further the quality of our Nation's waters, particularly in the area of toxic chemical contamination.

These 2 days of hearings come at a time when Congress begins consideration of the reauthorization of the Clean Water Act. As with the Clean Air Act, the Clean Water Act will involve substantial controversy. It is incumbent upon us, therefore, to determine whether a sound research base exists to support the proposed modifications to the Clean Water Act.

Today we will receive testimony from a very prestigious group of environmentalists and members of the academic community. In addition, we will hear from a representative of the U.S. Geological Survey, which is the Federal entity primarily responsible for water quality monitoring.

Before we hear from our distinguished witnesses, I would like to turn to counsel for the minority to see if they have any remarks to make.

[Mr. Scheuer's prepared statement follows:]

PREPARED STATEMENT OF HON. JAMES. H. SCHEUER

The Subcommittee on Natural Resources, Agriculture Research and Environment will come to order.

Today, we will examine the research needs necessary for successful implementation of the Clean Water Act.

Two primary goals of the Clean Water Act are to make the water of the United States fishable and swimmable by 1983 and to prohibit discharge of pollutants into navigable waters by 1985.

Although we have seen significant improvement in many areas of water pollution, contamination of our waters by toxic chemicals continues to be a very serious problem.

It is hoped that the recommendations received from our distinguished witnesses during these hearings will provide us with a valuable record on the short- and long-term research necessary to improve further the quality of our nation's waters, especially in the area of toxic chemical contamination.

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As with the Clean Air Act, the Clean Water Act will involve substantial controversy.

It is incumbent on us, therefore, to determine whether a sound research base exists to support the proposed modifications to the Clean Water Act.

Today, we will receive testimony from a prestigious group of environmentalists and academics.

In addition we will hear from a representative of the United States Geological Survey, the federal entity primarily responsible for water quality monitoring.

Ms. **BACH.** Mr. Chairman, The minority has no prepared statement for the record.

Mr. **SCHEUER.** All right. I would rule, in the absence of any objection, that the minority can submit their statements for the record, and that any member be entitled to ask any of the witnesses further questions in writing and that the record be kept open for 10 days so that both my distinguished colleagues on the minority side and any majority members can ask further questions in writing.

Mr. **SCHEUER.** Having said that, then, let's call the first panel of environmentalists, Mr. Thomas Jorling, professor at Williams College, and Mr. J. Taylor Banks, staff attorney, Natural Resources Defense Council.

In the interest of time, I am going to ask each of you gentlemen to speak for 6 or 7 minutes, hitting the highlights of your prepared testimony. Of course, your prepared statement will be printed in full at this point in the record. After you have both chatted with us briefly, I am sure we will have some questions for you.

So, Professor Jorling, why don't you begin.

STATEMENTS OF THOMAS C. JORLING, PROFESSOR OF ENVIRONMENTAL STUDIES AND DIRECTOR, CENTER FOR ENVIRONMENTAL STUDIES, WILLIAMS COLLEGE, WILLIAMSTOWN, MASS. AND JAMES TAYLOR BANKS, SENIOR STAFF ATTORNEY, NATURAL RESOURCES DEFENSE COUNCIL

Mr. **JORLING.** Thank you, Mr. Chairman.

I am pleased to be here to contribute to your review of the Clean Water Act, particularly the research aspects of that act and the programs it authorized. I am presently professor of environmental studies and director of the Center for Environmental Studies at Williams College, Williamstown, Mass. During the period 1977 to 1979 I served as Assistant Administrator of EPA for Water and Hazardous Material with the responsibility for implementation of the program and regulatory parts, that is, not the research and development parts of the Clean Water Act. From 1968 to 1972 I served as Minority Counsel to the U.S. Senate Committee on Environment and Public Works. During that time the 1972 Federal Water Pollution Control Act, now called the Clean Water Act, was enacted by Congress.

The 1972 act, as amended several times—most significantly in 1977—is working. The waters of the United States are cleaner. But there is a long way to go. In fact, controlling water pollution—that is, controlling releases to the environment, water or otherwise—will continue as long as man acts to manage, concentrate, synthesize, transport, and use water material and energy. We hope that will be a long time.

The lessons of implementation have been many, and some are especially relevant to the focus of your committee's inquiry—that is, research. First, we are in rapid transition. Until recently, the emphasis of water pollution control has been on gross manifestations of environmental disruption, pathogens, eutrophication, and aesthetic insult. Thus, the concerns were described in terms of generic pollutants, not really pollutants at all but characterizations such as oxygen demand and suspended solids.

Except for pathogens, measured almost exclusively by fecal coliform counts, little attention was paid to specific chemical pollutants. The 1972 act changed that orientation. But in changing it—and I might add, properly so—we found the research community way behind. We still have not the capacity on a routine basis to examine accurately the composition of chemicals in the multitude of waste streams that exist, or in sludges or in the ambient environment.

We can do it in carefully controlled and extremely well-equipped laboratories with significant resources. However, this is not a very prevalent condition. And with EPA's drastic cutback in R&D and in enforcement and regulation, we will see regression, not progress.

The transition I spoke of is by no means completed, and the deficiency in our ability to identify pollutants is among the most acute problems facing future achievement in water pollution control.

Before addressing general and specific concerns relating to research, it is necessary to review the general principles established by the Clean Water Act: principles that establish a framework within which all components of effective water pollution control fit.

The first principle is the principle of elimination of discharge, the favorite scapegoat of many critics of the 1972 law. This principle is the most forward oriented of the principles of the act. It speaks to the relationship of industrial and technological man to the environment over the long haul. It recognizes not only current dynamics in the management of material, but reflects future dynamics as well. It has its roots in view of the biosphere that providing life support to the billions upon billions of human beings who will occupy the Earth under any projection of the future is best assured by the maintenance of, in the words of the Clean Water Act, "the chemical, physical and biological integrity" of, in this case, the hydrosphere, but in a larger context, the entire biosphere.

It reflects the fact that the current population of some 4.5 billion will grow, and that if we assume, perhaps overly optimistically, a stable population of some 6.5 billion by the end of the next century, then in the next 500 years—

Mr. SCHEUER. Excuse me. I don't think you mean by the end of the next century. You mean by the end of this century.

Mr. JORLING. Well, the U.N. projection is for 6.5 billion by the end of the next century.

Mr. SCHEUER. I beg your pardon.

This is all off the record.

[Discussion off the record.]

Mr. SCHEUER. Please proceed.

Mr. JORLING. Mr. Chairman, your points are well taken. I have purposefully tried to be on the overly optimistic side and most conservative in my projections, in order to establish that in the next 500 years something on the order of 80 to 90 to perhaps 100 billion people will have occupied and acted out their lives in the biosphere. It reflects the view that these people will have high expectations for the use and support of materials, water, and energy, at least matching that already enjoyed by those of us in our current industrial society.

Thus, for instance, the current dynamics in chemical production for our Nation provide one indicator of our role, that is, mankind's role in the biosphere. Not only that, they provide a basis from which to conclude that the future will see the reality behind these figures and trends greatly exceeded.

I find it helpful in this respect to recall the U.S. production figures just in my lifetime. In the year of my birth, 1940, the production of synthetic organic chemicals in the United States was 1.3 billion pounds. In 1950, the year of the Korean conflict, it was 49 billion pounds. In the year of Camelot, 1960, it was 96.7 billion pounds. By Earth Day, 1970, it was up to 233.1 billion pounds, and by the middle year of my service with EPA, 1978, it was 320 billion pounds.

This is not to suggest that all of these chemicals are toxic, acutely or chronically. It is simply a measure of the scale of activity in the management of matter that industrial societies are routinely engaged in. There is the possibility of release of this material to the environment, accidentally or intentionally, at every stage in the management pathway—in the extraction of raw material, in the processing, in the manufacturing, in product use, and in disposal. The 1972 act established the principle that we should not lose custody of these materials; that over time it is futile to gauge how much can be released into the environment with no consequence; that it is a self-defeating task we simply can't catch up with, nor could we ever. It is prudent in the management of material to keep it under control. While it can't be done yet, it can be done, and that is what the act calls for. It is necessary if we are to have a secure future.

We—that is, we through our Government agencies—cannot know how many of the some 60,000 chemicals now in commercial use are being released to the environment. We cannot know how much quantity is being released. We cannot measure the effects on the entire aquatic, much less the entire biotic system. We have not the ability to know of all the effects in all of the circumstances that chemicals can be released, nor can Government agencies ever know these things. The knowledge base, even if theoretically achievable, is outside our resources grasp. What is not outside of our grasp is adherence to a principle that each of us, wherever we are, and whether we are individuals or corporations, should act to eliminate releasing materials to the environment and to confine and contain our waste. When we achieve that, and we can, and we can economically, then and only then are we and future generations secure.

The second principle of the Clean Water Act recognizes that pollution control cannot be achieved all at once, but that its scope over time must be comprehensive. It must address all waters, oceans, estuaries, and inland water. Parenthetically, I might add that we now see it isn't comprehensive enough in that it does not address directly ground water.

It must also address all sources, point and nonpoint, direct and indirect, industrial and municipal. Only by tightening up our management of material across the board will efforts succeed to protect the aquatic environment over the long haul. Similarly, it must and does address all pollutants.

The third overall principle of the act is phased implementation. Simply stated, it says move toward the goal in stages, or all the way, as it is economically achievable to do so. This principle is founded upon the commonsense notion that as we learn more, we can do more. As we shift from a reliance on wasteful, linear, throw-it-away assumptions, to recycle, reuse, conservation assumptions, our production and use patterns will change. From source separation, to process change, to abatement technology, to substitution, all are dynamic activities. They admit to the creative impulse of humans. Surprisingly, many of the critics of the act seem to be static, to be doubters, to imply we can't do. The 1972 act challenges, but it also provides the structure for change. It gives a clear goal and reasonable time to achieve it. It challenges our creative genius and that genius will respond.

The fourth principle is that of continuous research and development directed toward the overall objectives of the act. It is a principle rooted in a high regard for the creative impulse of man. In contrast to many critics of the act, it stems from the belief that "we can do." Now this principle seems threatened, not because it is in error, but precisely because it is on the threshold of success. The new administration not only has weakened resolve, it cuts back on the very engine of change and success—the R&D program.

The fifth principle is that environmental control requirements should not operate to afford competitive or economic advantage between and among any industrial or geographical sector. Throughout the 1960's and early 1970's industry, for good reason, clamored for clear, reasonable requirements, applied uniformly. They received their wish in 1972, although what some view as holding peoples feet to the fire, others view as unreasonable requirements. But uniformity of application is crucial. There are other than the obvious economic uniformity reasons for the principle. Simply put, States cannot look at economic power equal to some nations that are represented by large multinational firms, and not blink. They are incapable—and I emphasize "incapable"—of insisting on strong environmental controls without Federal backup, and even that, as I can attest from my own experience, is no match for some economic power.

Now we are hearing some in industry and in this administration petition for variance based on receiving water quality. In addition to avoiding costs of doing business, they seem to want to restore the pollution haven or economic blackmail phenomenon. Such a change, if adopted, would establish a program where the poor performers would drag down not only the good performers but overall national achievement as well.

The basic requirements of the act applicable to an industry are tied to performance already achieved by an appropriate plant in that industry category. In the case of BPT, best practical technology, it is an average of good performance already achieved. For BAT, best available technology, it is the performance, again already achieved, at the exemplary plant. Good achievers should set the mark when dealing with public trust property. But to hear some groups, especially trade associations, those good citizens who should be models for achievement, are, in fact, held up as examples for scorn and ridicule. Why do a good job if lobbyists can avoid the requirement?

I would now like to turn briefly to more general comments and specific comments that have a more direct bearing on research programs, both public and private.

First of all, we are beginning to see a shift in rhetoric from concern with controlling and abating releases of pollutants to an expression of concern for measuring adverse effects. I believe this to be very ominous. At best, it simply does not reflect any understanding of the dynamics of activities and processes that lead to release of pollutants. At worst, it represents a practice to avoid costs of pollution control. I am afraid the latter predominates.

On its face it sounds reasonable. If you can't show harm, it is OK. But it is a proposition that would knowingly shift to government an impossible burden, especially a diminished government at that. It is impossible to detect and measure all pollutants. It is impossible to evaluate the changes throughout the ecosystem of the release of such pollutants, especially over time. We can't make correlations even with gross effects. So what the position represents, as Brer Rabbit might say, "please don't throw my waste in the briar patch." It is an attempt to hoodwink the public.

But it is possible over time to eliminate the discharge of pollutants, and economically, and that is precisely what the BPT, BAT program provides. When we get there, think of how much better off we will all be, not just now, but over the many generations we hope will follow.

In part, the attitude is based on an ignorant, subconscious arrogance that, to the extent it is not seeking just to avoid environmental controls, believes we can know the fate and effect over time of increasing releases of chemicals into the environment. In their view, there will be some genius, presumably on the 12th floor of EPA's West Tower controlling valves all over everywhere, assisted by a marvelous computer, assuring that there is just the "right" release of pollutants or chemicals into the environment.

Behind that, however, is the age old and hopefully soon to be abandoned business idea that, if you can externalize your costs, you do it. This philosophy suggests it is acceptable behavior to externalize the burdens of your activity, until and unless the great "they" stop you. If you can get the environment and the public resources to handle your waste, you do it. Of course, the most clever of the lobbyists suggest that the public should even prove why they shouldn't.

But let us look at the reality. Industrial processes change the mix of chemicals they deal with—sometimes even hourly—as they shift from product to product. Farmers use different chemicals at different times. Different chemicals flow into public systems at different times——

Mr. SCHEUER. Excuse me. We are trying to stick to some kind of a timetable——

Mr. JORLING. OK. I'm almost finished, Mr. Chairman.

Mr. SCHEUER. [continuing]. And you have gone considerably over. I haven't wished to stop you because your testimony has been outstanding. But in fairness to the other witnesses, I would have to ask you to see if you could sum up in another minute or two.

Mr. JORLING. Mr. Chairman, two emerging activities on the part of the new administration are particularly threatening not only implementation of the Clean Water Act, but protection of public health as well. On the one hand EPA now suggests it won't act to regulate releases to the environment unless there is clear evidence of harm. On the other, it is cutting R&D drastically. In the case of toxic chemicals, this constitutes a policy of restoring the American people to a population of experimental animals. The committee must prevent this regressive, antipublic-health pattern from being established.

The Clean Water Act is sound. It requires better implementation, not less. If Congress will reaffirm the act, it will go a long way to fulfilling the promise it made earlier to the American people—clean, safe, and pleasing natural water courses.

Mr. Chairman, that completes my testimony and I will be happy to answer questions either now or later, as you desire.

[The prepared statement of Mr. Jorling follows:]

Testimony of Thomas C. Jorling
Subcommittee on Natural Resources,
Agriculture, Research and Environment
on
the Clean Water Act
Research and Development

June 8, 1982

Mr. Chairman and Members of the Committee, I am pleased to be here to contribute to your review of the Clean Water Act, particularly the research aspects of that Act and programs it authorized. I am presently Professor of Environmental Studies and Director of the Center for Environmental Studies at Williams College, Williamstown, Massachusetts. During the period 1977 to 1979 I served as Assistant Administrator of EPA for Water and Hazardous Material with the responsibility for implementation of the Program and Regulatory parts - that is not the R and D parts of the Clean Water Act. From 1968 to 1972 I served as Minority Counsel to the U.S. Senate Committee on Environment and Public Works. During that time the 1972 Federal Water Pollution Control Act - now called the Clean Water Act was enacted by Congress.

The 1972 Act - as amended several times most significantly in 1977 - is working. The waters of the United States are cleaner. But there is a long way to go. In fact controlling pollution - water or otherwise - that is controlling releases to the environment will continue as long as man acts to manage, concentrate, synthesize, transport and use water material and energy. We hope that will be a long time.

The lessons of implementation have been many and some are especially relevant to the focus of your committee's inquiry that is research. First. We are in rapid transition. Until recently the emphasis of of water pollution control has been on gross manifestations of environmental disruption; pathogens, eutrophication, aesthetic insult. Thus the concerns were described in terms of generic pollutants - not really pollutants at all but characterizations such as oxygen demand, and suspended solids. Except for pathogens - measured almost exclusively by fecal coliform counts, little attention was paid to specific chemical pollutants. The 1972 Act changed that orientation. But in changing it and properly so, we found the research community way behind. We still have not the capacity on a routine basis to examine accurately the composition of chemicals in the multitude of waste streams that exist, or in sludges or in the ambient environment. We can do it in carefully controlled and extremely well equipped laboratories with significant resources - not a very prevalent condition. And with EPA's drastic cutback in R&D, in enforcement, and in regulation we will see regression not progress. The transition is by no means completed - and the deficiencies in our ability to identify pollutants is among the most acute problems facing achievement in water pollution control. You will hear, I am sure, much about expense and cost - for instance, the many millions that have been spent in issuing effluent guidelines under Section 301. Most of this expense has been incurred as a function of acquiring good, reliable, quality controlled information on the pollutants present in industrial waste streams. It is simply not achievable in any other way.

Before addressing general and specific concerns relating to research it is necessary to review the general principles established by the Clean Water Act. Principles that establish a framework within which all the components of effective water pollution control fit.

The first is the overall principle of elimination of discharge, recycle, and confined and contained disposal of waste. The second principle is comprehensive scope; all sources, point, non-point, industrial, municipal. The third is phased implementation. The fourth is the principle of on-going research and development leading to satisfaction of the first two principles I mentioned, from both new and existing facilities and activities. And the fifth principle is that pollution control should not operate to cause economic advantage or disadvantage between and among any industrial or geographical sector. Let us look briefly at each of these.

The first is the principle of elimination of discharge, the favorite scapegoat of many critics of the 1972 law. This principle is the most forward oriented of the priciples of the Act. It speaks to the relationship of industrial and technological man to the environment over the long haul. It recognizes not only current dynamics in the management of material, but reflects future dynamics as well. It has its roots in a view of the biosphere that providing life support to the billions upon billions of human beings who will occupy the earth under any projection of the future is best assured by the maintenance of, in the words of the Act, "the chemical, physical and biological integrity" of in this case, the hydrosphere, but in a larger context the entire biosphere. It reflects the fact that the current population of some 4.5 billion will grow, and that if we assume, perhaps overly optimistically a stable population of some 6.5 billion by the end of the next century then in the next 500 years something on the order of 80-90 perhaps more than 100 billion people will have occupied and acted out their lives in the biosphere. It reflects the view that these people will have high expectations for the use and support of materials, water and energy -

at least matching that already enjoyed by those of us in our current industrial society.

Thus, for instance, the current dynamics in chemical production for our nation provide one indicator of our role in the biosphere. Not only that they provide a basis to conclude that the future will see the reality behind these figures and trends greatly exceeded. I find it helpful in this respect to recall the U.S. production figures just in my lifetime. In the year of my birth, 1940, the production of synthetic organic chemicals in the U.S. was 1.3 billion lbs. In 1950, the year of the Korean conflict, it was 49 billion lbs. The year of Camelot, 1960, it was 96.7 billion lbs. By Earth Day, 1970, it was up to 233.1 billion lbs., and by the middle year of my service with EPA, 1978, it was 320 billion lbs. This is not to suggest that all of these chemicals are toxic, acutely or chronic. It is simply a measure of the scale of activity in the management of matter that industrial societies are routinely engaged in. There is the possibility of release of material to the environment, accidentally or intentionally, at every stage in the management pathway; in the extraction of raw material, in the processing, in manufacturing, in product use, and in disposal. The 1972 Act established the principle that we should not lose custody of these materials; that over time it is futile to guage how much can be released with no consequence; that it is a self-defeating task we simply can't catch up with, nor could we ever. It is prudent in the management of material to keep it under control. While it can't be done yet, it can be done. It is what the Act calls for. It is necessary if we are to have a secure future.

We, that is we through our government agencies, cannot know how many of the some 60,000 chemicals now in commercial use are being released to the environment. We cannot know how much quantity is being released. We cannot measure the effects on the entire aquatic, much less the entire biotic system. We have not the ability to know of all the effects in all the circumstances that chemicals can be released. Nor can government agencies ever know these things. The knowledge base, even if theoretically achievable, is outside our resources grasp. What is not outside of our grasp is adherence to a principle that each of us, wherever we are and whether we are individuals or corporations should act to eliminate releasing materials to the environment and to confine and contain our waste. When we achieve that - and we can - and we can economically - then and only then are we, and future generations secure.

The second principle recognizes that pollution control cannot be achieved all at once but that its scope over time must be comprehensive. It must address all waters, oceans, esturaries and inland water. Parenthetically I might add that we now see it isn't comprehensive enough in that it does not address directly ground water.

It must also address all sources, point and non-point, direct and indirect, industrial and municipal. Only by tightening up our management of material across the board will efforts succeed to protect the aquatic environment over the long haul. Similarly, it must address all pollutants.

The third overall principle of the Act is phased implementation. Simply stated it says move toward the goals in stages - or all the way - as it is economically achievable to do so. This principle is founded upon the common sense notion that as we learn more, we can do more. As we shift from a reliance on wasteful, linear, throw it away assumptions - to recycle, reuse, conservation assumptions, our production and use patterns will change. From source separation, to process change, To abatement technology, to substitution, all are dynamic activities. They admit to the creative impulse of humans. Surprisingly, many of the critics of the Act seem to be static, to be doubters, to imply we can't do. The 1972 Act challenges, but it also provides the structure for change. It gives a clear goal and reasonable time to achieve it. It challenges our creative genius and that genius will respond.

The fourth principle is that of continuous research and development directed toward the overall objectives of the Act. It is a principle rooted in a high regard for the creative impulse of man. In contrast to many critics of the Act it stems from the belief that "we can do." Now this principle seems threatened. Not because it is in error, but precisely because it is on the threshold of success. The new Administration not only has weakened resolve, it cuts back on the very engine of change and success, the R&D program.

The fifth principle is that environmental control requirements should not operate to afford competitive or economic advantage between and among any industrial or geographical sector. Throughout the 1960's and early '70's, industry, for good reason, clamored for clear, reasonable requirements - applied uniformly. They received their wish in 1972, although what some view as holding peoples feet to the fire, others view as unreasonable requirements. But uniformity of application is crucial. There are other than the obvious economic uniformity reasons for the principle. Simply put, states cannot look at economic power equal to some nations that are represented by large multi-national firms, and not blink. They are incapable - I emphasize incapable - of insisting on strong environmental controls without federal backup and even that - as I can attest from my own experience - is no match for some economic power.

Now we are hearing some in industry and this Administration petition for variation based on receiving water quality. In addition to avoiding costs of doing business, they seem to want to restore the pollution haven, economic blackmail phenomenon. Such a change, if adopted, would establish that the poor performers should drag down, not only good performers, but overall national achievement as well.

The basic requirements of the Act applicable to an industry are tied to performance already achieved by an appropriate plant in that industry category. In the case of BPT it is an average of good performance already achieved. For BAT, it is the performance, again already achieved, at the exemplary plant. Good achievers should set the mark when dealing with public trust property. But to hear some groups, especially trade associations, those good citizens who should be models for achievement are in fact held up as examples for scorn and ridicule. Why do a good job if lobbyists can seek to avoid the requirement?

I would now like to turn to more general comments and several specific comments that have a direct bearing on research programs both private and public.

First of all, we are beginning to see a shift in rhetoric from concern with controlling and abating releases of pollutants to an expression of concern for measuring adverse effects. I believe this to be very ominous. At best it simply does not reflect any understanding of the dynamics of activities and processes that lead to release of pollutants. At worst it represents a practice to avoid costs of pollution control. I'm afraid the later predominates.

On its face it sounds reasonable, if you can't show harm, it is O.K. But it is a proposition that would knowingly shift to government an impossible burden, especially diminished government at that. It is impossible to detect and measure all pollutants, it is impossible to evaluate the changes throughout the ecosystem of the release of such pollutants, especailly over time. We can't make correlations with even gross effects. So what the position represents - as Brer Rabbit might say - "please don't throw my waste in the briar patch." It is an attempt to hoodwink the public.

But it is possible over time to eliminate the discharge of pollutants - and economically - and that is precisely what the BPT, BAT program provides. And when we get there, think how much better off we will be, not just now - but over the many generations we hope will follow.

In part, the attitude is based on an ignorant subconscious arrogance that, to the extent it is not just seeking avoidance of environmental controls, believes we can know the fate and effect over time of increasing releases of chemicals into the environment. In their view there will be some genius presumably on the 12th floor of the West Tower controlling valves all over everywhere, assisted by a marvelous computor, assuring that there is just the "right" release of chemicals into the environment. Behind that, however, is the age old and hopefully soon to be abandoned business idea that if you can externalize your costs you do it. This philosophy suggests it is acceptable behavior to externalize the burdens of your activity - until and unless the great "they" stop you. If you can get the environment and the public resources to handle your waste, do it. And, of course, the most clever of the lobbyists suggest that the public should even prove why they shouldn't.

But let us look at the reality. Industrial processes change the mix of chemicals they deal with - sometimes even hourly as they shift from product to product. Farmers use different chemicals at different times. Different chemicals flow into public systems at different times. It is not unappropriate to visualize a government official running about trying to find out what is being released, then what its effects are, then finding a shift in release. Its all crazy, especially when the 1972 Act alternative is so sound. Focus on mechanisms, processes, systems under a policy to avoid release. That is where the research and development programs should be headed. But they are not. The chemicals released, the circumstances of their release and the receiving waters are so varied, it is simply folly over the long term to base a pollution control program on them. We can achieve a chemically tight society and that should be the thrust, not only of government research - but also industrial research.

Government research should be directed to solving those problems where the activities are so diverse and inherently complicated so as not to be borne as a part of the cost of doing business, such as agriculture, urban runoff related pollution. Industrial and municipal direct discharge related research should by and large be a cost of doing business and the government role should be review and quality control and assurance rather than doing the principle work.

Generally, both the federal and state governments must perform the work necessary to provide background and trends. This is not yet being done properly and one major factor is the cost of acquisition and operation of the equipment - primarily a gas chromatograph mass spectrometer. Most states are especially weak in this regard. Part of the problem is the cost and reliability of the equipment under routine use. Hopefully, the technology will continue to improve - but in the meantime both Federal and State governments have to develop higher standards of quality control and assurance and operator professionalism.

Mr. Chairman, two emerging activities on the part of the new Administration are particularly threatening not only implementation of the Clean Water Act, but protection of public health as well. On the one hand EPA now suggests it won't act to regulate releases to the environment until there is clear evidence of harm. On the other, it is cutting R&D drastically. In the case of toxic chemicals, this contributes a policy of restoring the American people to a population of experimental animals. The Committee must prevent this regressive pattern from being established.

The Clean Water Act is sound. It requires better implementation, not less, or as the new Administration seems to be moving, contrary implementation. If Congress will reaffirm the Act it will go along way to fulfilling the promise it earlier made to the American people; clean, safe, pleasing natural water courses.

Mr. Chairman, that completes my prepared statement. I'll be pleased to answer any questions the Committee might have.

Mr. **Scheuer**. All right. We will go to the other witness first. But I do want to commend you on the excellence of your testimony.

I feel this very deeply and emotionally, the remarkable success of the Clean Water Act. I guess I am one of the few urban Congressmen who could say that honestly from experience in his own district. I represent the Jamaica Bay area of New York, that vast inland body of water, and it used to be a favorite haunt for fishing, crabbing, and hunting for clams and lobsters and scallops. Of course, all of that has been long gone.

But the building of tertiary sewer plants and other activities under the Clean Water Act have brought a dramatic change to the quality of the water in Jamaica Bay. It is now swimmable, for the first time in almost a century. We have a beautiful Irish community called Broad Channel, perched right on Jamaica Bay, with homes built on stilts over the water. Ancient Hibernians come up to me, stooped, aged, and say, "Congressman, for the first time since 1905, when I went clamming with me daddy, I am going out with me grandchildren and we're finding clams and scallops in Jamaica Bay. Congressman, what you're doing is a wonderful thing." I wish I could import to you the joy and the pleasure on the faces of these elderly people who for the first time since they were kids are enjoying the pleasures and delights of fishing and clamming and crabbing in Jamaica Bay. As Americans, I think we all should take pride.

Mr. **Jorling**. I think so, too, Mr. Chairman. There are instances like that across the country and I think the key to it has been, and will continue to be steadfastness on the part of the Government in seeking to carry out these goals.

Mr. **Scheuer**. Thank you, and thank your for your excellent testimony, Mr. Jorling.

Mr. **Scheuer**. Now we will proceed with Mr. Banks of the Natural Resources Defense Council. Take your 7 or 8 minutes and help us avoid the embarrassment of gaveling you down, Mr. Banks.

Mr. **Banks**. Thank you, Mr. Chairman. I will try to be brief. I appreciate the opportunity to discuss EPA's research and development program as it pertains to water quality.

Interestingly, today marks the sixth birthday, if you will, of a document commonly known as the Flannery decree. Six years ago today, Judge Flannery signed a court order establishing this country's first comprehensive toxic water pollution control program. We all expected that program to be over in 1979 but, despite Tom Jorling's best efforts, it now looks as if we will be worrying about that effort until at least 1984.

The Flannery decree takes a two-stage approach to toxic pollution control. In the first generation, it requires what are commonly known as technology-based controls. For those sources discharging directly into water, the controls are called effluent guidelines. For those discharging into sewers leading into municipal treatment plants, they are called pretreatment standards. But in both cases, they are based on the concept of best available technology.

The focus of this program is on 65 specific chemicals and on 21 major classes of industry. And by definition, this first generation of controls must be economically achievable. The most important feature, as Mr. Jorling has pointed out, is that these controls do not depend on answering difficult scientific questions that may take years, indeed decades, before we can actually answer them to the degree that we would want in order to specifiy specific controls on a given chemical for a given waterway.

The second generation of controls under the decree, however, does try to answer those questions. It takes a targeted, site-specific and scientific approach to toxic controls. Only where the first generation of controls are shown to be inadequate to protect human health and aquatic life are the second generation of controls called for. They are a fine-tuning, if you will, of the basic thrust of the program.

In order to accomplish that, the consent decree requires EPA to do two things. First, EPA must establish ambient criteria for the priority toxic pollutants that would protect aquatic life and human health when those pollutants are discharged into surface waters. Second, EPA is to identify what we call hot spots of toxic pollution—places in this country where there are now toxic problems from industrial discharges—and to devise specific, tailormade cleanup stategies to deal with those toxic hotspots.

What I would like to do in the brief time I have this morning is outline where I think we are on the first and second generation of controls, discuss briefly where I think EPA is going in both of those programs, and conclude by offering several suggested priorities for the research program based on what I see as the status of those efforts right now.

In general, a lot of work has been done under this program. I think EPA has spent something on the order of $200 million trying to issue these controls. As to the first generation of controls, there are two industries now regulated out of 24 major categories that should be addressed. The administration has taken only one action since January of 1981, and that was the issuance of a regulation covering the iron and steel industry 2 weeks ago. EPA is now contemplating more delays and, as I mentioned earlier, their schedules probably would stretch out to the middle of 1984.

The court, on the other hand, appears to be tired of this foot-dragging and has ordered EPA to finish the program within a year. We will have to see whether that, in fact, is going to take place.

We have learned recently that in the long run EPA plans to regulate approximately one-third of those industries at a level that would require actual clean up of toxics beyond controls that are currently in place.

As to the second generation, EPA has published the final ambient criteria for 64 out of 65 chemicals. Those criteria and the documents on which they are based are incomplete and, in fact, Dr. Hernandez has been very critical and has belittled those studies at every opportunity.

As to the hotspot studies, they are a complete mess. EPA first identified last year 34 metropolitan areas in which it believes there are streams that have serious toxics problems. Then, when NRDC publicized the results of those studies, EPA belittled its own research and, in fact, in the press called those studies guesswork. Then, a few months ago, EPA issued its so-called strategy to deal with those toxic hotspots, and the strategy amounted to nothing. It doesn't deal with any of the hotspots. In fact, it directs the States to go back and do what EPA was supposed to have done some years ago—identify problems caused by toxics being discharged from industries in their areas.

EPA has attempted in court to get out of all of these responsibilities. As I mentioned, the court has now said No. We will have to wait and see what will happen with these programs, if anything, but at the moment I am not encouraged.

In short, I think this program is not in great shape. It's objectives can be accomplished ultimately, but at the moment it is in pretty poor condition. The first generation of controls are weak and are long overdue. The second generation have shown no useful results so far.

Having said that, where is EPA headed with the program? I think it is fairly clear by now that EPA intends to switch strategies, from this current emphasis on the first generation, to a more site-specific water quality based system of controls that would be devised by State decisionmakers and not by EPA. Put another way, EPA plans to skip the first generation and go directly to the second.

We are seeing it in EPA's proposal for a waiver from pretreatment standards that would be based on some assessment of water quality and toxic effects that, as Professor Jorling pointed out, cannot be made. We see it in EPA's open support for the concept of a waiver from best available technology in the Clean Water Act. And we see it in EPA's emphasis on State action in its strategy to deal with hotspots, rather than on Federal research that would identify those problem areas and try to cope with them. As you know, this is precisely the opposite direction from which Congress has been going since 1972.

The difficulty with this approach, obviously—and the reason why Congress has decided not to try to take a site-specific approach to toxics—is that we don't have the information to decide how clean the water should be and then develop strategies to clean it up. EPA simply does not know where there are problems; they do not know the levels at which there are problems; and they do not even know whether we are dealing with all of the chemicals that should be addressed.

By way of conclusion, then, let me try to offer what I think are the necessary priorities to overcome these uncertainties. But in order to do that, let me set it up this way:

The priorities for the research program would be the same whether you accept EPA's current emphasis on water quality controls or whether you prefer the Flannery decree and its emphasis on technology based standards. The only difference is whether you take those priorities as a short-term measure or a long-term measure. NRDC would argue to you that we cannot view these research priorities as a short-term measure because they cannot be done in the short term. We have to view them as long term and, meanwhile, take some steps to clean up toxic discharges. EPA would argue that you need to look at them as a short-term objective for their regulatory program. But in either case, the objectives are the same, and they are these three:

First, we have to figure out where—which water bodies in this country—have toxic discharge problems. In order to know that, we have to figure out who is discharging into them, what chemicals are being discharged, and the levels at which those discharges cause problems to aquatic life and to human health. EPA doesn't know. EPA doesn't have a clue where those problems are. And at the moment, they are not pursuing a research strategy that would answer those questions.

The second priority—and I think I have already mentioned it—is to determine what are the acceptable levels of toxic pollutants. As Tom Jorling pointed out, there probably is no easy answer to that in our lifetimes. But if we are going to try to target pollution as EPA wishes, or go beyond the current generation of controls, as NRDC and Congress have wished, then we are going to have to at least try to address that problem. Currently, EPA's research program does not address it.

Finally, and I think perhaps the most important, EPA should begin to ask: "Are we dealing with all the toxic chemicals that are problems out there?" The current list of priority pollutants was devised in the course of settling a lawsuit 6 years ago, with lawyers sitting on either side of a table, backed up by scientists. We don't know at this moment whether those are all of the toxic chemicals that ought to be addressed. One of the most important priorities for EPA's R&D program, it seems to me, ought to be to answer that question.

Mr. Chairman, I know time is short, so I will conclude my remarks and answer any questions you might have.

[The prepared statement of Mr. Banks follows:]

PREPARED STATEMENT OF JAMES TAYLOR BANKS

Through our litigation and administrative monitoring, NRDC has paid close attention to EPA's toxic water pollution control program for a very long time. I believe our efforts over the past 10 years place us in a unique position to evaluate the Agency's progress, and provide us an excellent vantage point from which to assess the future of the Agency's program. Through four administrations, we have watched EPA stumble, fall, regain its footing and now stumble again. Sadly, I think EPA is about to fail once more.

Last October, I testified before Congressman Toby Moffett's Subcommittee on Environment, Energy and Natural Resources and titled my statement "EPA's Blueprint For Reversing a Decade of Progress Toward Clean Water." At Chairman Moffett's request, I summarized the status of EPA's toxics program, and discussed a number of actions by the new administration at EPA that I believe are designed to undermine that program.*/

Unfortunately, the situation has grown worse, not better, over the past 7 months. My conclusion is that EPA's toxics program is getting off the track. That program is quite mature as environmental efforts go; indeed, today is the sixth birthday of the widely known "Flannery Decree" in which EPA's obligations are embodied. The new administration took over last year -- just as many of the toxics regulations were ready to be issued. Since then the only positive action EPA has taken was the issuance of one regulation for the iron and steel industry. With the exception of that rule (which we believe is too weak and perhaps unlawful in some respects), EPA has made every effort to delay and ultimately alter this important national program. As I pointed out in October:

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*/ A copy of my written statement is submitted for the record.

° EPA has delayed regulations governing toxic discharges into waterways even though nearly all of the technical and analytical work is complete. The Agency has asked for a revision of the Flannery Decree that would allow until mid-1984 to complete rules that should have been issued by the end of 1979. EPA cited budget cuts as one of the primary reasons for these delays. But EPA budget documents show that the new administration first decided to delay this program, and then proposed to cut its own budget.

° EPA decided not to proceed with case-by-case toxics permitting for those industries as to which regulations will be extremely late. Some industries (particularly organic chemicals producers) will have only a few months to achieve compliance with toxics requirements because their rules will be delayed until just prior to the Act's July 1, 1984 deadline.

Recognizing the dilemma, the last administration developed a strategy of defining treatment requirements for those industries on a case-by-case basis in the permit process rather than waiting for the regulations. Over a year ago we urged Ms. Gorsuch to pursue the same strategy, but she decided not to do so. Consequently, there is growing pressure to amend the Act to delay the 1984 deadline.

° Soon after taking office, the new administration suspended regulations governing the national pretreatment program for indirect toxics dischargers. The action was taken without notice or opportunity for public comment, and despite NRDC's litigation aimed at reinstating the regulation, EPA has effectively halted the program for the past year.

° EPA refused to complete its responsibilitiy to indentify hot spots of toxic pollution, and sought a modification of the Flannery Decree to delete its obligation to do so. These identifications would set the agenda of priorities for future toxics control beyond the current level of abatement. EPA first said it had completed this task -- citing streams in 34 metropolitan areas as the nation's "most polluted" -- but then belittled its own studies when NRDC made the Agency's findings public.

What ties these separate actions together is this: the new administration intends to discard the Act's current approach to toxics control (nationally uniform technology based limits) and revert to the approach Congress abandoned in 1972 (site-specific controls based on ambient standards). If EPA could delay the existing program long enough, it could propose the necessary statutory amendments to carry out this strategy.

Congress abandoned the site-specific approach for good reason -- it did not work even for conventional pollutants, let alone for toxics. And EPA officials know that the old approach cannot be adapted to exotic toxic chemicals about which scientists and engineers know very little. The Office of Research and Development as estimated that the necessary tools and data will not be available for another decade -- even if funding remains at an appropriate level. We all know that is an unrealistic expectation.

What we have, then, is an administration determined to reverse Congressional policy by blocking or delaying regulations, ducking legal commitments, and generally creating a situation in which these mandatory, statutory programs cannot work. If EPA fails to complete these programs, indeed attempts to prove them unworkable, then the stage will be set for amending the Clean Water Act to fit the Agency's agenda. As I pointed out in October, we think that is precisely what is going on, and that the consequences will be quite severe: a program that cannnot work anytime soon without enormous additional resources.

In the remainder of my statement, I would like to describe several developments that have been added to EPA's Blueprint since October, and then conclude by considering the implications of this plan for EPA's research program.

First, EPA has continued its efforts in court to delay and abandon the key elements of the National toxics strategy.[*/] Based on shifting and sometimes conflicting excuses, the Agency has asked for a much longer schedule to issue toxics regulations. And based on nothing but the Administrator's wishes, EPA has asked the court to relieve it from its research-oriented obligations. For example, EPA hopes to avoid having to:

- identify toxics hot spots and develop individual strategies to curtail sources of toxic pollution;
- complete the development of ambient water quality criteria for the priority toxic pollutants; and
- fininsh its program to determine whether there are additional toxic pollutants that should be regulated in discharges from industrial sources.

On May 7, 1982, U.S. District Judge Thomas Flannery denied each of EPA's requests.[**/] The Agency is obligated to pursue

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[*/] A copy of NRDC's recent brief describing these actions is submitted for the record.

[**/] A copy of Judge Flannery's May 7, 1982 opinion and order is submitted for the record.

all of its existing responsibilities, and to pursue them much more promptly than EPA had hoped. All of the industry-specific rulemaking must be completed within one year, and EPA will not be permitted to continue using the same worn-out excuses for delay.

Second, EPA has clarified its intention to abdicate important water quality responsibility to the States. In February, EPA released its so-called strategy for controlling industrial discharges into toxic hot spots. Rather than setting out a plan to further refine its identification of these hot spots and systemmatically address them, EPA proposed to leave the whole process to the states. The states, not EPA, would make the necessary identifications of problems through their revision of water quality standards (a three-year process). The so-called strategy contains no proposal for actions to address these problems, and makes no mention of the problem areas identified by EPA last year.*/

Moreover, through the water quality standards revision process, EPA plans to encourage systemmatic downgrading of the goals and requirements through which the Clean Water Act operates. The Agency is circulating a draft proposal to amend regulations governing how the states establish their standards under the Act. The new regulation would all but abandon the statute's anti-degradation concept, remove existing barriers to downgrading beneficial use designations, and eliminate special protection for oustanding national resource waters such as those found in national parks. It even suggests that good water quality need not be protected where a stream is too shallow for swimming and canoeing.

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*/ A copy of NRDC's March 15, 1982 letter to EPA regarding this problem is submitted for the record.

The combination of these two actions -- (1) leaving toxics priority setting to the states, and (2) downgrading the ambient basis for state cleanup requirements -- guarantees that these hot spots will not be addressed anytime soon. It also means that building the scientific foundation for ambient, site-specific controls should be among the Agency's most crucial research priorities of the 1980's. States simply cannot carry this burden without massive assistance from their federal partner.

The third development in recent months is EPA's agenda of proposals for amending the Clean Water Act. First released in April and then formally transmitted to Congress on May 25, the Agency's plan amounts to an astonishing collection of special-interest loopholes. It is a major retreat from the Act's objective of achieving prompt, uniform control of toxic industrial discharges. And like the other actions described above, EPA's proposal moves away from federal responsibility toward a scheme based on site-specific decisionmaking and long delays.

NRDC has prepared a detailed analysis of EPA's agenda, and I submit a copy for the record of these proceedings.*/ The Agency proposal has numerous weakening amendments, but the most important are these three:

- The Pretreatment Retreat

EPA proposes to: (1) abandon mandatory, national pretreatment standards for toxic industrial discharges into municipal sewage plants; and (2) create waivers for any industries that EPA may choose to regulate. This is a major retreat from the Act's emphasis on uniform treatment technology for industrial toxics. The proposal would eliminate long-standing federal leadership in this area, and place enormous financial and political burdens on the cities by requiring scientific and technical investigations for which there are not enough data, methods or technical resources. As a result, the serious toxics problems caused by these discharges will continue.

- Rollback of BAT Deadlines

EPA proposes to: (1) delay its duty to issue "best available technology" (BAT) regulations for toxics until July 1, 1984; (2) remove its obligations to review BAT rules every year; and (3) roll back industrial dischargers' compliance deadline from 1984 to 1988. These amendments are designed to undermine EPA's court-ordered responsibilities on toxics control, and to give industry an inordinate stretchout of their obligations. EPA has promised a U.S. District Court that it can issue all of the regulations before 1984 -- some as soon as this spring. Moreover, while dischargers usually need 2-3 years to comply with a rule, EPA's proposal will grant them 4-6 years. For each year that BAT regulations are delays, EPA has estimated that over 100 million pounds of toxic chemicals will be discharged to the Nation's waters. This is far too high a price for EPA's unjustified delays.

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*/ NRDC also has published a series of articles on this and other facets of the upcoming Clean Water Act reauthorization in its quarterly publication, The Amicus Journal. A copy of the Winter 1982 issue in submitted for the record.

- Ten-Year Permits: No Further Progress for a Decade.

EPA proposes to increase the maximum term of all Clean Water Act permits from 5 years to ten. This increase will ensure that polluters are protected from more stringent requirements under the Act for a decade. There will not be opportunities to require upgraded treatment -- even if justified by advances in technology, cost-saving innovations, discoveries of new toxics hazards, or decisions by states to incresase the protection of their water resources.

These actions have brought EPA's Blueprint a long way since October. As I have stressed repeatedly, the Blueprint signals several fundamental shifts in the federal government's approach to pollution control. And it seems to me that these shifts suggest clear directions for EPA's research and development program.

EPA's new emphasis is on site-specific standard setting that involves predictions of the effects toxic pollutants will have on water quality, aquatic life and human health. This emphasis is seen in the Agency's abdication of its hot spot strategy, the renewed dependence on state standards, and the proposed introduction of variances into the Act's regulatory structure. At every turn, EPA's Blueprint depends on scientific knowledge that will enable the state or local decisionmakers to determine where controls are needed and how much control is needed to prevent unacceptable toxic effects.

These are extremely difficult questions, and EPA's performance thus far is not encouraging. The Agency was given four years to develop ambient criteria for the 65 priority toxics, for example, and did such a poor job that deputy Administrator Hernandez has belittled the results at every opportunity. When NRDC made public EPA's hot spots list, Agency officials went to great extremes to dismiss their findings as "guesswork."

In short, EPA does not know how bad these chemicals are; it does not know where they are polluting our waters; it does not know whether there are additional chemicals we should be concerned about; and, most important, EPA has made every effort to avoid any legal duty to answer these questions. And yet the Agency's apparent control strategy depends heavily on obtaining such answers.

We have urged Congress to resist the Agency's thrust toward relying on a strategy that depends so heavily on these scientific imponderables in the near term. We believe the current generation of controls should remain premised on the ability of economically achievable treatment systems -- leaving for the next generation the difficult questions about toxic effects that can be answered only after years of intensive research. But whether this Committee agrees on the question of timing, it seems obvious that EPA's research program must address these fundamental questions sooner or later.

Specifically, we believe EPA research should emphasize the following areas:

1. What are the levels at which toxic pollutants have unacceptable effects on human health and aquatic life and, can we accurately measure discharges at those levels?

2. Where are discharges into water bodies actually exceeding those levels, and what are the sources of those discharges?

3. Are EPA's regulatory programs addressing all of the toxic pollutants about which we should be concerned?

These should be the basic objectives of EPA's R&D program. If EPA shifts its regulatory strategy, they would have to be met in the next year or two. In fact, EPA budget documents demonstrate that they will not:

> At the FY 1981 level (and assuming zero inflation), the needed technical data base could be completed, but not field validated, by approximately 1990.

Given EPA's proposed budget cuts for R&D (58% in funds and 24% in personnel between 1981 and 1983), these objectives probably will never be met. We hope this Subcommittee will take a long, hard look at that fact.

Mr. SCHEUER. I appreciate, also, your very excellent testimony. You both discussed the administration's new thrust and the change they are making, the deadlines, pretreatment, and exemption from certain requirements.

If these proposed amendments are incorporated into the act, what would be the result to our water quality programs, and how would these amendments affect toxic pollution control efforts? I would like to hear from both of you on this.

Mr. JORLING. Mr. Chairman, I believe that the amendments, to the extent they deal with toxics and pretreatment, would have the effect of codifying the intended strategy of EPA, which is basically to do either very little or do nothing. Therefore, they are asking Congress to bless that kind of activity.

It is obvious that the reality is that some of the dates do need adjustment to reflect the fact that the guidelines have not been issued and therefore time is necessary after issuance for compliance, but certainly not the kind of broad, open-ended extension that the administration proposes. We need to keep the feet of my administration to the fire. I can attest from my own experiences as an administrator that the will of Congress influences the behavior of agencies to act. If the relaxation were granted by Congress now, the agency would relax and would, in my judgment, do nothing.

That is especially true when taken in the context of the present budgeting activity within the Environmental Protection Agency. They are simply cutting back on their capacity to do anything, so that the two together, these amendments plus their budgeting, would cause, in my judgment, very little forward movement in pollution control and ironically as the emphasis is now on toxics. Therefore, there would be significant delay in our ability to control the release of millions of pounds of toxic chemicals into the environment in the next 4 years.

Mr. SCHEUER. Thank you.

Mr. BANKS. Mr. Chairman, there are two kinds of changes being suggested to the Clean Water Act. One is just a flat rollback of deadlines, and we all know what that would mean. EPA has estimated that perhaps 100 million pounds of toxic chemicals could be discharged every year that those deadlines are rolled back.

The other is more subtle and I think probably more serious, and that is this variety of waivers and other provisions that would base future controls of toxic chemical discharges on some proof that there is harm to human health or aquatic life. Those are going to cause delays that we can't even measure, because, in fact, we can't answer those questions. EPA, if it has its way, is going to set up a system that places the burden on a State or local decisionmaker to demonstrate that there is a problem with a toxic chemical discharge. Believe me, with the ability of lawyers to litigate scientific questions like that forever, we probably will not see controls in the next decade or two.

Mr. SCHEUER. I am struck by this anomalous and somewhat ironic thrust of EPA. On the one hand the administration is telling us that we have to be more cost effective, that we have to stop—in the regulatory process that Congress and its extension in the regulatory agencies—shooting with a blunderbuss and we have got to start shooting with a high-powered rifle and an 8-power scope, and that we have to stop burdening industry with control technologies and limitations on pollution, that are not cost effective; that is, where the benefits don't clearly exceed the costs.

Now, in effect, what they are saying is "You have to know more than you know now in order to shoot with a high-powered rifle and an 8-power scope. You have to fine tune your thinking to the point where you can demonstrate to us that the benefits to society clearly outweigh the costs."

But at the same time of telling us we have to be far more knowledgeable and have a far more sophisticated data base in order to regulate, they are cutting back on the only hope of achieving that data base, which is Government financed R&D. Even industry representatives tell us that they regret this cutback because they want our regulations to be more cost effective; they want to be able to draw a line between silly and very expensive and not very productive pollution control efforts, and efforts that really make common sense, that really achieve a very desired result in improving our water environment at manageable cost and at sensible cost.

They feel the only way for us to avoid burdening industry with unreasonable costs to achieve dubious benefits is for us to improve our knowledge and data base. So, regardless of party, and regardless of orientation, most of us want to improve the environment and most of us want to protect the integrity and the viability of our industry. We want to be competitive globally. We want to sell our goods and services around the world. We don't want to impose needless, pointless burdens on industry. The very tool that we need to function the way the public wants us to function, the way industry wants us to function, and presumably the way the administration wants us to function, the very tool of knowledge that we need to do our job better is being denied to us, or would be denied to us, by what I consider to be the thoughtless and totally counterproductive cuts that have been suggested by industry.

Mr. JORLING. Mr. Chairman, when someone cuts the stem of a rose and says it is improving the circulatory system, it leads one to conclude either they are buffoons or they are being deliberately misleading. I leave to your judgment which of those two conclusions is appropriate in this regard. But that certainly is what EPA is asking us to do at this time.

Mr. SCHEUER. Let me just ask you both for the record to answer this question: How should we in Congress react to the administration's proposals for change, waivers, delays, stretchouts, et cetera, on the reauthorization of the Clean Water Act? If you can be as specific as you possibly can on each of the various proposals by the administration, and if you would wish to elaborate on your answer somewhat in written replies, that would be perfectly welcome. But if you can give us a laundry list of actions that you would like to take in response to the administration's suggestions, please give them to us now.

Mr. BANKS. Let me take a shot at that, Mr. Chairman—and I will be brief.

NRDC has prepared about a 50-page analysis of the administration's bill, and it is submitted for the record of these proceedings with your permission.

The high points of those administration proposals are these three things: The first is a major overhaul of the pretreatment program. We recommend that you reject that—send it back to the Administrator of EPA, and say "we don't want to hear about that." The second is a proposal to extend the life of permits from 5 to 10 years. We suggest that you ask the administration and the industry proponents to demonstrate a need for such an extension. The third is this so-called BAT waiver proposal, which is not in the administration's bill but has been described publicly as an objective the administration would support if Congress chooses to devise such a provision. On that point we suggest that Congress decline the opportunity, and tell the administration "No thank you." In sum, I would say send the administration's proposal back, or set it aside and start from some other basis to reauthorize the Clean Water Act.

Mr. JORLING. Mr. Chairman, I would not add any more, except to urge that Congress not take steps that would reward poor performance. The achievement that has been made by those people out there should be rewarded, and that means everyone should be brought up to that level. The administration's amendments, when taken in general, have the effect of bringing the good performers down to the poor performers. I think Congress should reject that.

Mr. SCHEUER. Thereby providing an enormous disincentive for anybody to do anything that they don't absolutely have to do, in which they absolutely aren't under the gun to do in the future.

Mr. JORLING. That's correct.

Mr. SCHEUER. So, in effect, you would be penalizing the enlightened, forward-looking statesman in the corporate community, and encouraging and supporting the most backward, most unimaginative, most selfish elements of corporate leadership.

I'm a graduate of the Harvard Business School, and they taught me back in those ancient days about the great enlightened corporate leadership in this country, and I have believed that ever since and I believe it now, and I want to continue believing it. But I must say there has been a great vacuum of that leadership in part of the American industry that is involved in manufacturing and utilities in spoiling our air and spoiling our water. There are some leaders out there, but there are many more foot draggers among the corporate leaders of these industries.

It seems to me, what our national policy should be is to enhance the credibility and the prestige and the excellent sense of responsibility that those few forward-looking corporate executives have taken.

Mr. JORLING. Mr. Chairman, I think it is noteworthy in that regard to point out the Japanese are not relaxing their environmental controls, and yet they are outcompeting us in the marketplace.

Mr. SCHEUER. They are outcompeting us in the global marketplace, and unless we can get our act together, we're going to find that we have virtually been squeezed out of global markets and automobiles, steel, electronics, computers, sophisticated telecommunications, and other fields. It is not because of their wage rates and it is not because what they have spent in environmental controls. It is because they have organized themselves and they have provided long-term financing over a decade or more to industries that are producing products that seem promising. They have organized their management-labor relations to reduce it to almost an invisible confrontation between labor and management. They have done a much better job of rationalizing their resources than we have.

We are looking for easy outs. We are looking for quick fixes, both in eliminating these environmental programs, reducing them, stretching them out, and in trying to set up quotas and import barriers to foreign-made products. That is not the answer. The answer is not to seek by these industrial quick fixes to become competitive. The answer is to get our act together and become competitive and continue working for the environment and continue working to maximize the health of the American people.

We appreciate your testimony very much. You were both excellent witnesses, and I am sure we will have some further questions for you that we will submit in writing. I have already gotten unanimous consent to do that for all members of the subcommittee. With that, I thank you very much for your excellent testimony.

Mr. **Jorling**. Thank you, Mr. Chairman.

Mr. **Banks**. Thank you.

Mr. **Scheuer**. We will now go to the next panel from academia, Prof. Joe Moore of the University of Texas, and also assistant administrator of wastewater operations to the mayor of Detroit; Dr. Ray Loehr, professor of engineering at Cornell University; and Dr. Gerard Rohlich, professor of environmental engineering at the University of Texas at Austin.

Gentlemen, as you heard, your prepared testimony will be printed in full at this point in the record, and we will ask each of you to sum up, hit the highlights of your testimony in about 7 minutes, and feel free to react to each other, react to anything you have heard here at this hearing this morning or what you have read in the newspapers, anything that is relevant. I am sure after the three of you have chatted with us, we will have some questions for you.

Again, I suggest to you that I and other members of the panel may be submitting further questions to you in writing, and we are going to hold up the record for 10 or 12 days in order for us to do that.

So why don't we proceed as I introduced you. First, Mr. Moore.

STATEMENTS OF JOE G. MOORE, JR., PROFESSOR OF ENVIRONMENTAL SCIENCES AT THE UNIVERSITY OF TEXAS AT DALLAS; GERARD A. ROHLICH, PROFESSOR OF ENVIRONMENTAL ENGINEERING AND PUBLIC AFFAIRS, UNIVERSITY OF TEXAS AT AUSTIN; AND RAYMOND C. LOEHR, PROFESSOR OF AGRICULTURAL ENGINEERING AND ENVIRONMENTAL ENGINEERING, CORNELL UNIVERSITY

Mr. **Moore**. Mr. Chairman, I am Joe G. Moore, Jr., a professor who teaches environmental regulation in the graduate program for environmental sciences at the University of Texas at Dallas. I am also simultaneously assistant administrator to the mayor of the city of Detroit, Mich., attempting to bring the Detroit wastewater treatment plant into compliance with the Clean Water Act, the

Clean Air Act, the Resource Conservation and Recovery Act, and State and local ordinances and regulations currently in effect. That plant is being operated under Federal district court order and has been now for some 3 years.

Also, I am a former chairman of the Texas Water Quality Board and was the Commissioner of the Federal Water Pollution Control Administration at the time water quality standards were being adopted and administered throughout the Nation. The Federal Water Pollution Control Administration subsequently became a part of the Environmental Protection Agency.

My remarks are restricted to the experience I have had in the field and come from the perspective of an administrator in the field of water pollution control.

First, I would like to caution the committee with regard to testimony you will hear about the improvement in water quality in the Nation. The variability in the statistical data base upon which an assessment can be made is such that any general characterization of changes in water quality over time, particularly if such changes relate to specific parameters, is suspect because of the historical accumulation of data and the variations that exist in the data that is being used for making such assessments.

In addition, the modeling for predictions about the future condition of water quality under stated conditions is also very crude and can, at best, only reflect static conditions in a very dynamic system. Modeling, I think, has been overrated in terms of predicting what the future water quality is likely to be. So, be skeptical of claims and statistics supporting claims of improvement in general water quality.

At the same time, I would have to admit, and freely state, that there has been improvement in the quality of the Nation's waters in specific places throughout the country. The National Commission on Water Quality, for which I was program director, analyzed some 45 specific sites in the country with regard to the impact of the 1972 Water Pollution Control Act amendments and discovered that there had, indeed, been a documented change in water quality that could be attributed to the national water pollution control program.

In addition, the Environmental Protection Agency, late in 1980, issued a publication—the copies are apparently scarce in Washington because I had trouble finding one to at least call the committee's attention to the report—entitled "National Accomplishments in Pollution Control, 1970 to 1980, Some Case Histories." I refer the committee to that particular report because it summarizes, admittedly with some press agentry on the part of the Agency itself—but it does summarize some case histories in which there has been a demonstrated improvement in the environment.

Unfortunately, the topic with which the committee has to deal is one that, so far as environmental issues are concerned, arises in what I can only characterize as adversarial science. It may be that the very nature of the environmental issues and the lack of information about them creates the adversarial relationship between scientific experts. With a conflict of scientific information and scientific advice, I think it is natural that policymakers, whether in the legislative or executive branch, and increasingly in the judicial branch, I think it is natural that those policymakers should view with some consternation the conflicting information that is provided to them.

Unfortunately, policymakers have to make decisions upon the best available information, and issues are invariably addressed long before all the facts are known. As an administrator in the field of water pollution control, I have become accustomed to taking the risk that is associated with deciding issues long before everything is known.

It is also inevitable that in the scientific process, as you proceed with the analysis of questions, you inevitably raise additional questions which the scientist is inclined to say should be thoroughly analyzed and studied before the original question is responded to, and inevitably that leads to the impression that you should postpone all decisions until all information is known. Of course, if one waited until that occasion arose, there would no longer be an issue, because issues arise by virtue of the uncertainty that exists in the real world.

Now, in this arena, then, of adversarial science it is extremely important that the data not be a part of the controversy, if that condition can be realized. First, the data base is inadequate and has been for as long as I have been associated in the field, which is some 17 years. Monitoring is inadequate. Both the data base and the monitoring systems are not necessarily consistent, nor is the data reported in comparable form so the policymakers can adequately deal with the information that is provided.

Scientific opinion is therefore divided, and the basis of regulations is constantly being challenged. Thus, people in administrative positions or policymakers often find themselves performing a judicial function, that is, choosing among the conflicting recommendations provided by different scientific experts. That may be inevitable, but certainly, if we can change it, we should attempt to do so.

I shall briefly summarize what is contained in my statement with regard to the suggestions that I would offer to your committee for its consideration.

Regular, systematic, and periodic monitoring of the quality of the Nation's waters is essential to, one, the evaluation of actions already taken, two, to the measurement of improvements or degradation of water quality, and three, to the making of valid decisions in the future.

However and wherever monitoring is performed, the adequacy of the system will be determined by the money allocated to the task, and an adequate system is expensive to establish and maintain. Present levels of financial support by all levels of government are inadequate.

The monitoring system, collection techniques, the parameters measured, the testing protocols, the analytical methodology used, and the storage of the data should be determined by the most eminent scientists in the nation to minimize these matters becoming a part of the problem rather than a part of the solution.

EPA should take the lead in assuring that the data development, collection, and storage has the highest possible scientific credibility. This administration, the current Administrator, and the Agency's Deputy Administrator in particular, have pledged to assure a credible scientific basis for their decisions. They should be provided every assistance in this effort.

There is little evidence that Government-funded research sponsored by EPA and its predecessor agencies, one of which I at one time headed, has produced dramatic advances in water pollution control. A clearly defined, consistent role for such research does not now exist.

Research intended to develop regulations, criteria, or standards, or that necessary to establish testing protocols or standard methodologies, should probably remain an in-house or EPA-directed activity. Some outside scientific oversight by a body of scientists not beholden to the Agency should periodically evaluate EPA's performance.

The validity of water quality modeling is routinely assumed or overstated. More attention should be given to perfecting such models, and their limitation should always be explained to those who must make decisions based upon their output.

Analysis of all issues related to toxic substances should be given highest research priority. Regulations prescribing technologies for toxics removal or treatment should not be issued for any toxic substance for which there is not yet an EPA promulgated testing protocol or standard methodology.

The wide installation of treatment technologies for removal of pollutants from water is creating a new, but predictable, problem of residuals accumulation—that is, solids, sludges, and slurries. Contrary to public perception, little has been accomplished in the destruction of pollutants. In most instances, we have merely removed them from one environmental medium—air, water or the land—and transferred them to another. Now we are confronted with the problem of sludges generated by more effective wastewater treatment. High priority should be given to research into the treatment, neutralization, decomposition, and safe disposal of the sludges from water and air pollution control measures. Land disposal, burying them, is not the most environmentally sound solution in every case.

Whether monitoring and data collection can be successfully decentralized depends upon EPA's commitment for quality assurance, that is, making certain that these activities, wherever performed, meet a national standard of scientific validity and comparability. In the final analysis, the adequacy of the data base will be determined by the total money dedicated to its accumulation. Whether the funds come from the Federal, State, or local level is immaterial, so long as the collected data is valid and comparable.

There is considerable expressed misgiving about allowing local variations from nationally prescribed standards. As our environmental knowledge expands and matures, such modifications are almost inevitable. If there is to be some local flexibility, then those who wish to exercise that flexibility must recognize and accept the responsibility to finance the costs to justify and enforce any permitted variation.

Assignment to EPA at this time of responsibility for regulation of ground water quality should be approached with care and much deliberation and study by the Congress. The interrelationships that affect this resource are considerably more complex and variable than are those for surface water. Much less is known on a national scale about ground water than is known about surface water. Launching a new regulatory effort by EPA would require considerably more time and resources than are available and would detract from other programs not yet perfected by the Agency. States should be encouraged and allowed to put their own systems in place before concluding that only a national program can be effective.

Thank you, Mr. Chairman. I will be glad to answer questions at the appropriate time.

[The statement of Mr. Moore follows:]

Statement of
Joe G. Moore, Jr.
before the
Subcommittee on Natural Resources, Agriculture Research and Environment
of the
Committee on Science and Technology
U.S. House of Representatives.
June 8,1982

I am Joe G. Moore, Jr., Professor in the Graduate Program in Environmental Sciences at The University of Texas at Dallas and Assistant Administrator to the Mayor of the City of Detroit, Michigan, who as Administrator is responsible for bringing the Detroit Wastewater Treatment Plant into compliance with Federal, State and local air and water pollution control and solid waste disposal statutes under a Federal District Court Order. My statements here today represent my personal views and should not be attributed to either of these employers.

There are several very important facts that I believe are essential to any consideration of current water quality in the United States:

1. The statistical data base is generally inadequate to characterize the exact quality of any body of water for a lengthly time span or for a wide range of quality parameters. Some judgments can be made but only in gross terms, i.e., " this body of water or stretch of stream is polluted all the time" or " this one is of very high quality ". The data base and methodology is grossly inadequate to classify the nation's waters according to any acceptable scientific system.

2. The extreme variability of the physical, chemical and biological parameters that characterize water quality cannot now be adequately modelled by existing computers at a reasonable cost; thus, predictions of changes in water quality are based upon very crude technology with elementary analytical means.

3. Statements about the current or future quality of any body of water or stretch of stream are invariably based upon a series of very important, but rarely explicitly stated, assumptions that form the basis for the assessment and are often critical to any understanding or evaluation of what is being said.

In summary, this Committee should be skeptical of any unequivocal conclusions or predictions about the quality of the nation's waters. The process for fixing and achieving water quality standards is far from an exact science.

Having said all this, I will make one of those unequivocal statements about which I have warned you, "The quality of some of the nation's water is better than it was ten years ago and it is probable that very little of it is any worse for those parameters which we can easily measure."The evidence lies in the absence of some things, i.e., there aren't as many--nor as massive--fish kills as there once were. There are some positive signs--Lake Erie didn't die, and the fish are venturing into places where they didn't formerly go, and in numbers that suggest they can survive.

Lest these encouraging signs give us a sense of false hope, we have also learned some things in these ten years that raise some alarming questions. The realization that man-made toxic chemicals can have insidious longterm effects upon man's health has raised new alarm. This pollutant contribution is undoubtedly worse than it was ten years ago, if only because we don't know all we need to know. That lack of knowledge compounds our fears.

The Staff Report to the National Commission on Water Quality (for which I was Program Director) analyzed some 45 specific sites across the nation to determine whether improvement was occurring. Also, the E P A, late in 1980, catalogued the environmental improvement it had detected for the preceding decade, albeit with some Madison Avenue press agentry, in a report. Your Committee will find the case studies described in these reports instructive, and I will not detail them here.

You have heard, and will hear, much discussion of the scientific basis for the water quality standards now in place, including the water quality criteria and their application to local, site-specific bodies of water. The "waste load allocation" process and the "total maximum daily loads" will be dissected and criticized for you. More than likely, these will be presented to you as absolutes when in reality they are mere approximations based upon the current level of scientific knowledge and analytical tools. Any nationally developed and uniformly imposed standard will be arbitrary somewhere in the country. The broader the area for which the standard or criteria is prescribed, the more arbitrary it will be. A single, universal national yardstick or prescription is most attractive to legislators, regulators, bureaucrats and administrators. The Clean Water Act provides authority for the Administrator to establish, by regulations or guidelines, many such standards or effluent limitations.

Reliable, consistent, uniform, comparable historical scientific data do not exist for all parameters of concern now included in these regulations, guidelines or limitations. The law merely requires that the best scientific information available be utilized by the Administrator and, in some instances, that additional information be collected. In the absence of a well established widely accepted scientific data base, issues raised by proposed regulations are settled in an arena of adversarial science, with the credibility of the individaul scientist or group of scientists having substantial influence up the chosen course of action. The E P A Administrator and the supporting staff are often forced to assume a judicial role in choosing between conflicting scientific advice much as a judge or jury is expected to do in a true judicial proceeding. Because those initially responsible for developing regulations under the Clean Water Act elected to promulgate very detailed, very precise regulations, scientists supporting or challenging the regulations have been compelled to attribute to their data a level of accuracy difficult to substantiate. In other words, the lack of well established widely accepted data base has sometimes expanded the area of disagreement to include the credibility of the data itself as well as ~~to~~ the issue the data was intended to resolve.

Adversarial science is not the best method for resolving water quality or treatment technology issues. Preferably, scientific questions should be settled by competent, respected scientists. The National Academies of Science and Engineering have performed a similar role for some environmental issues under the Clean Air Act and an Advisory Committee form the Academies to the National Commission on Water Quality made recommendations concerning water quality questions. Even the Academies' members, however, are not agreed that this is a proper role for their organizations, and scientists within and outside them have publicly disagreed with their peers' findings and conclusions.

The adversary relationship between scientist advocates may be inherent within the environmental issues. If all the pertinent interrelationships were well known and widely understood, the issues would be much narrower and possibly more manageable. Substantial lack of knowledge about a subject of public concern may contribute to the depth, breadth and intensity of the disagreement about how best to arrive at a satisfactory solution. Adversary science may be a fact of life for the foreseeable future in water quality matters until a more adequate data base is developed and widely disseminated.

Approaching the area of your Committee's interest from this perspective, "I offer the following suggestions for your consideration:

1. Regular, systematic, periodic monitoring of the quality of the nation's waters is essential to (1) the evaluation of actions already taken, (2) the measurement of improvments or degradation of water quality and (3) the making of valid decisions in the future.

2. However and wherever monitoring is performed, the adequacy of the system will be determined by the money allocated to the task, and an adequate system is expensive to establish and maintain. Present levels of financial support by all levels of government are inadequate.

3. The monitoring system, collection techniques, the parameters measured, the testing protocols, the analytical methodology used, and the storage of the data should be determined by the most eminent scientists in the nation to minimize these matters becoming a part of the problem rather than a part of the solution.

4. E P A should take the lead in assuring that the data development, collection and storage has the highest possible scientific credibility. This Administration, the current Administrator, and the Agency's Deputy Administrator in particular, have pledged to assure a credible scientific basis for their decisions. They should be provided every assistance in this effort.

5. There is little evidence that Government funded research sponsored by E P A and its predecessors has produced dramatic advances in water pollution control. A clearly defined consistent role for such research does not now exist. If all the research funds thus far expended have not produced any dramatic advances, the validity of current practices should be examined. If E P A in-house long term research is not substantially different from that conducted in universities and other research institutions, then its continuance should be evaluated upon the basis of benefits. One advantage of research funded through universities is the training of students that results.

6. Research intended to develop regulations, criteria or standards or that necessary to establish testing protocols or standard methodologies should probably remain an in-house or E P A directed activity. Some outside scientific oversight by a body of scientists not beholden to the Agency should periodically evaluate E P A's performance.

7. The validity of water quality modelling is routinely assumed or overstated. More attention should be given to perfecting such models, and their limitations should always be explained to those who must make decisions based upon their output.

8. Analysis of all issues related to toxic substances should be given highest research priority. So much fear exists about chemicals in the environment that money and resources will undoubtedly be spent to prove, in some instances, that no problem in fact exists. Only with more precise, comprehensive knowledge can the size of the problem be determined. Regulations prescribing technologies for toxics removal or treatment should not be issued for any toxic substance for which there is not yet an E P A promulgated testing protocol or standard methodology.

9. The wide installation of treatment technologies for removal of pollutants from water is creating a new, but predictable, problem of residuals accumulation (solids, sludges and slurries). Contrary to public perception, little has been accomplished in the destruction of pollutants. In most instances, we have merely removed them from one environmental medium (air, water or land) and transferred them to another. Now we are confronted with the problem of sludges generated by more effective wastewater treatment. High priority should be given research into the treatment, neutralization, decomposition and safe disposal of the sludges from water and air pollution control measures. Land disposal, burying them, is not the

most environmentally sound solution in every case.

10. There is much discussion of decentralizing many E P A functions to States and localities. Those discussed here, primarily research, do not readily lend themselves to this course of action. Whether monitoring and data collection can be successfully decentralized depends upon E.P.A.'s committment for quality assurance, i.e.,making certain that these activities,wherever performed, meet a national standard of scientific validity and comparability. In the final analysis, the adequacy of the data base will be determined by the total money dedicated to its accumulation; whether the funds come from the Federal, State or local level is immaterial so long as the collected data is valid and comparable.

11. There is considerable expressed misgiving about allowing local variations from nationally prescribed standards. As our environmental knowledge expands and matures, such modifications are almost inevitable. As gross water pollution is overcome, more complex and site-specific quandaries confront the regulators. Costs become more identifiable with expected results. While the water pollution control program has had a national focus and impetus for ten years, the impacts of polluted water are usually site specific. So long as there is a mechanism which allows those most directly affected to reach the source of the pollution, some local variation is permissable. For long interstate rivers such as the Missouri, Colorado, Ohio and Mississippi, the only course available to those adversely affected by upstream dischargers is the power of the Federal government to control interstate matters. That course should remain available through a strong Federal enforcement capability. If there is to be some local flexibility, too, then those who wish to exercise that flexibility must recognize and accept the responsibility to finance the costs to justify and enforce any permitted variation.

12. Assignment to E P A at this time of responsibility for regulation of groundwater quality should be approached with care and much deliberation and study. The interrelationships that affect this resource are considerably more complex and variable than are those for surface water. Much less is known on a national scale about groundwater than is known about surface water. Launching a new regulatory effort by E P A would require considerably more time and resources than are available and would detract from other programs not yet perfected. States should be encouraged and allowed to put their own systems in place before concluding that only a national program can be effective.

Mr. SCHEUER. Thank you very much.

Now we will go to Dr. Gerard Rohlich, professor of environmental engineering, at the University of Texas at Austin.

Dr. ROHLICH. Thank you, Mr. Chairman. I appreciate this opportunity to testify on certain aspects of the Clean Water Act, particularly with regard to research needs.

As you have pointed out, I have been a professor of environmental engineering at the University of Texas at Austin for the past 10 years. Prior to that time I was professor of environmental engineering at the University of Wisconsin at Madison, served as a member of the board of the department of natural resources for the State of Wisconsin, and worked closely with the people in Wisconsin in developing their water law.

After hearing Mr. Moore, I feel somewhat like the student Ph. D. who was coming up for examination on his final dissertation. The professor said, "I have read your dissertation and it has many good things and many new things. Unfortunately, the good things are not new, and the new things are not good." So many of the good things I may say have already been said by Mr. Moore.

This committee I am sure is well aware that considerable effort has been made by the EPA to define its research agenda in the publication of the annual "Research Outlook" reports which were mandated by Congress some 5 or 6 years ago. These reports outline the Agency's projected 5-year research and development plans and include discussions of ongoing research projects and research priorities determined by EPA to be necessary to meet its responsibility to "identify, evaluate, and control environmental pollutants."

The question of research priorities is of particular importance at this time in view of the proposed decreases in the Agency's research and development budget. Of critical concern is the impact that budget constraints may have on the continued development of our environmental information base, particularly with regard to toxic pollutants.

The scientific and technical complexity of the toxic substances problem presents the greatest challenge that we have faced, in my experience, during the past 50 years. The problems include major concern with regard to human exposure and health risks, the impact of toxic substances on ecological systems, analytical capabilities for identification of toxic substances, synergistic and antagonistic effects of mixtures of toxic substances, effectiveness and costs of available technology for control, and the transport and transformation of toxic pollutants in the environment.

For example, it is just as important to know the impact of the environment on the toxic substance as it is to know the impact of the substance on the environment. Transformations in the environment may often produce less, more, or equally toxic materials. About this, we know very little at this time.

Each of these subjects requires a continuing and expanding need for additional funding for water pollution research. The list of subjects with high priority can be extended, beyond the toxic substances category, to include additional research on water treatment, improved analytical methods for detection and enumeration of viruses and other infectious agents such as helminths and protozoa, control of contaminants from energy development, and systems for protection and rehabilitation of ground water, as was mentioned by Dr. Moore.

We have had more than 50 years of commitment to research on the identification and control of conventional pollutants. As a result of that research, and our experience, we are able to predict the effects of, and to prescribe technology for the control of, conventional pollutants with a high level of confidence. By comparison, research on toxic pollutants is in the primary stages of development, even though significant contributions are being made by the several Federal agencies involved in the national toxicology program.

The building of a scientifically sound research program on which to base regulatory decisions regarding toxic substances must receive a high priority from both Congress and the EPA. The magnitude of the anticipated budget cuts makes this a difficult challenge. Under the proposed fiscal year 1983 budget, funding for EPA's water quality research will be decreased from the estimated 1982 level of $28,562,000 to $13,341,000. Because funds will be so limited, it is clear that all the research needs cannot be supported. It is likely that many ongoing projects will have to be eliminated or severely curtailed.

Recently I put together some numbers with regard to the money spent on research in this country, and the research and development expenditures in the industrial sector for all purposes represents about 2.2 percent of the gross national product. When one looks at the expenditures for research in EPA, just as a basis of the moneys expended for construction grants programs, the research expenditures are less than six-tenths of 1 percent. And that does not include the expenditures for pollution control facilities that are going on in industry. That is just a percentage of the construction grants. So I think it is clear that the amount of money that is being spent at the present time is really quite small in connection with the work that needs to be done.

I will expand a little bit on some of these points, Mr. Chairman, in my written testimony, and then I'll move on.

Now, if the research agenda under the current budget constraints must be developed this way without additional funds, I believe that particular attention needs to be paid to two major subjects, which I will mention briefly. One, improvement in coordination and quality assurance of water quality monitoring programs. I might say that the monitoring that Dr. Moore has mentioned—and I didn't know of his testimony until this morning, so there is considerable overlap—there are really three stages in monitoring that I think need to be stressed:

One is the source monitoring, in which we are determining the amounts of materials and toxic substances that originate at sources and are discharged. Second is the ambient monitoring question in which we determine the amount of these materials that are present in the environment—in our case, the water environment—and the third is the effects monitoring question, that is, what are the effects of these particular toxic materials in the environment in the conditions in which they exist in the environment.

Obviously, the effectiveness of a water quality control program is reflected in improvements in ambient quality which is determined by an adequate monitoring program. Despite the large commitment of funds during the 1970's to water quality improvement projects, there remains uncertainty and differences of opinion as to the extent of improvement in the quality of the Nation's waters. In 1980 an interagency task force on environmental data and monitoring identified more than 100 water monitoring programs carried out by 20 Federal agencies with annual expenditures of $275 million. The task force concluded that there was a serious lack of coordination and quality assurance among the monitoring programs. The fragmentation of monitoring programs and variability of data contribute to the climate of uncertainty regarding ambient water quality.

The National Resources Research Council made a study and also cited inadequate coordination with too little attention to assessing individual programs in terms of their contribution to an overall national environmental program.

A second point that I would like to make is the question of the necessity for the development of scientifically based water quality standards and effluent limitations guidelines and standards for toxic substances, which has already been discussed this morning by others.

The implementation, effectiveness, and enforcement of the water quality management program needed to achieve the goals of the Clean Water Act requires the development of criteria, standards and regulations. Standards have a long history in environmental management and control and the systems and procedures leading to the adoption of standards, as specific numerical values or in broad general terms, are based on societal goals or objectives that are expressed as public policy. These goals, of course, have been expressed very clearly in the Clean Water Act.

The standards, thus, are the operational yardsticks related to the goals and become the technical and legal basis for enforcement. Successful implementation of water quality management programs requires that standards have a strong scientific base and that identification and monitoring programs be explicitly defined so that valid comparisons can be made as to the degree of success in meeting the target goal. Careful monitoring also provides evidence which can be used to refine the criteria and measurement program. The process is dynamic. Standards should be flexible. Once established, they may be the latest word, but they should never be considered as the last word.

Mr. SCHEUER. Dr. Rohlich, I wonder whether you could sum up.

Dr. ROHLICH. Yes.

I merely want to point out that we need to have both ambient water quality standards and effluent limitations. The ambient standards can be considered as the objective, and the effluent standards as the means. It seems to me both of these need to be considered in the program.

Finally, I would like to say it is hypocritical to claim that water is one of our most precious resources if we fail to commit the resources needed to build an effective system for water quality management.

Thank you.

[The prepared statement of Dr. Rohlich follows:]

PREPARED STATEMENT OF GERARD A. ROHLICH, PROFESSOR OF ENVIRONMENTAL ENGINEERING AND PUBLIC AFFAIRS, UNIVERSITY OF TEXAS AT AUSTIN

Mr. Chairman and Members of the Committee.

I am Gerard A. Rohlich, Professor of Environmental Engineering and Professor of Public Affairs at the University of Texas at Austin. I appreciate this opportunity to testify on certain aspects of the Clean Water Act.

The members of this Committee are well aware that considerable effort has been made by the EPA to define its research agenda in the publication of the annual "Research Outlook" reports mandated by Congress. These reports outline the Agency's projected five year research and development plans and include discussions of on-going research projects and research priorities determined by EPA to be necessary to meet its reponsibility to "identify, evaluate, and control environmental pollutants".

The question of research priorities is of particular importance at this time in view of the proposed decreases in the agency's research and development budget. Of critical concern is the impact that budget constraints may have on the continued development of our environmental information base, particularly with regard to toxic pollutants.

The scientific and technical complexity of the toxic substances problem presents the greatest challenge that we have faced, in my experience, during the past fifty years. The problems include major concern with regard to human exposure and health risks, the impact of toxic substances on ecological systems, analytical capabilities for identification of toxic substances, synergistic and antagonistic effects of mixtures of toxic substances, effectiveness and costs of available technology for control, and the transport and transformation of toxic pollutants in the environment. (It is just as important to know the impact of the environment on the toxic substance as it is to know the impact of the substance on the environment. Transformations in the environment may produce less, more, or equally toxic materials.) Each of these subjects requires a continuing and expanding need for additional funding for water pollution research. The list of subjects with high priority can be extended, beyond the toxic substances category, to include additional research on water treatment, improved analytical methods for detection and enumeration of viruses and other infectious agents such as helminths and protozoa, control of contaminants from energy development, and systems for protection and rehabilitation of ground water.

We have had more than fifty years of commitment to research on the identification and control of conventional pollutants and as a result of this research, and our experience, we are able to predict the effects of, and to prescribe technology for the control of, conventional pollutants with a high level of confidence. By comparison, research on toxic pollutants is in the preliminary stage of development even though significant contributions are being made by the several federal agencies involved in the National Toxicology Program.

The building of a scientifically sound research program on which to base regulatory decisions regarding toxic substances must receive a high priority from both EPA and the Congress. The magnitude of the anticipated budget cuts makes this a difficult challenge. Under the proposed fiscal year 1983 budget, funding for EPA's water quality research will be decreased from the estimated 1982 level of $28,562,000 to $13,341,000. Because funds will be so limited it is clear that all the research needs cannot be supported. It is likely that many on-going projects will have to be eliminated or severely curtailed. In making this determination of priorities, expanded use of peer review is needed.

It should be noted that environmental research and development is carried out by several federal agencies. In 1980, EPA's research and development program accounted for approximately one-quarter of all federally funded environmental research. In view of the likelihood of decreases in the research budgets of other agencies it becomes even more critical that closer coordination of the research activities and prompt exchange of information among agencies be effected.

The proposal to abolish the Water Resources Council and the Office of Water Research and Technology and to substitute an Office of Water Policy for these agencies at a fraction of the current funding level is likely to curtail the coordinating activities that these agencies had performed.

Internally, EPA has made progress in coordinating research activities through the development of quality assurance programs to promote reliability of data collected by the agency and in providing better oversight of projects. Currently about 85% of EPA research is directed to short-term research and 15% to to projects having a long-term focus.

In developing the research agenda under current budget constraints particular attention should be paid to:

1. Improvement in coordination and quality assurance of water quality monitoring programs.

Obviously the effectiveness of a water quality control program is reflected in improvements in ambient quality which is determined by an adequate monitoring program. Despite the large commitment of funds during the 1970's to water quality improvement projects there remains uncertainty and differences of opinion as to the extent of improvement in the quality of the nation's waters. In 1980 an inter-agency task force on environmental data and monitoring identified more than 100 water monitoring programs carried out by twenty federal agencies with annual expenditures of approximately $275 million. The task force concluded that there was a serious lack of coordination and quality assurance among the monitoring programs. The fragmentation of monitoring programs and variability of data contribute to the climate of uncertainty regarding ambient water quality.

The findings of a 1977 study by the National Research Council study group on environmental monitoring remain relevant. The study group found:

> "Programs are too often developed hastily in response to the dictates of legislation and enforcement procedures and the exigencies of pollution control management, instead of being based on clear objectives, priorities, and criteria related to a national monitoring system. As a result, current monitoring does not adequately serve the important purposes of evaluating the progress of national

> environmental programs in terms of changes in environmental quality and of determining the relationships among sources of pollution; ambient environmental quality; and effects on humans, animals, and plants".

The NRC Report also cited inadequate coordination with too little attention to assessing individual programs in terms of their contribution to an overall national environmental program, and the need to monitor with an eye for anticipating and discovering environmental problems before they become acute.

The American Chemical Society and the Council on Environmental Quality have stressed the need for improved quality assurance procedures in water monitoring programs. As pointed out by the American Chemical Society:

> "Support must be maintained at an adequate level for the programs of standardization, collaborative testing and quality assurance necessary to establish the equivalency and reliability of analytical methods and instruments. This support should extent to the development of calibrating materials for analytical instruments and of appropriate standard reference materials".

In addition to improved coordination and quality assurance procedures, the monitoring programs must include additional attention to the identification of toxic substances in the evaluation of water quality.

2. Development of scientifically based water quality standards and effluent limitations guidelines and standards for toxic substances.

The implementation, effectiveness, and enforcement of the water quality management program needed to achieve the goals of the Clean Water Act requires the development of criteria, standards, and regulations. Standards have a long history in environmental management and control and the systems and procedures leading to the adoption of standards, as specific numerical values or in broad general terms, are based on societal goals or objectives that are expressed as public policy. The standards thus are the "operational yardsticks" related to the goals and become the technical and legal basis for enforcement. Successful implementation of water quality management programs requires that standards have a strong scientific base and that identification and monitoring programs be explicitly defined so that valid comparisons can be made as to the degrees of success in meeting the target goal. Careful monitoring also provides evidence which can be used to refine the criteria and measurement program. The process is dynamic. Standards should be flexible, once established they may be the lastest word, but they should never be considered as the last word.

The Clean Water Act incorporates both ambient water quality standards and effluent limitations and standards. In my opinion both the technology based effluent limitations and the water quality standards are needed for a successful program. One can consider the ambient standards as the objective and the effluent standards as the means. Effluent standards without ambient standards suggests certainty about the resulting fate, concentrations and effects of the effluents in the environment.

Ambient standards without effluent standards leads to difficulty in control or means for enforcement, particularly if the fate of the substances in the environment is not clearly understood.

There remain many gaps and uncertainties in our knowledge of toxic substances. If water quality standards and technology for control of toxic substances are to be improved a continuing research effort covering the broad listing of topics mentioned above must be supported.

An important point in considering the appropriate effort for water quality research and development is the costs to society of not filling the information gaps. Delays in toxic research programs can result in:

1. Risks to human health and the environment in continued exposures to toxic substances;
2. Inability to anticipate emerging environmental problems which often forces regulatory agencies to adopt a reactive mode rather than a preventive posture;
3. Inability to develop fair and effective regulations because of the lack of a reliable information base. This frequently undermines the credibility of water quality management programs and generates a climate of adverserial confrontation and litigation;
4. Additional administrative costs associated with rebuilding research programs at a later date. Considerable human and financial resources are involved in the EPA's research program. Curtailment of the program and restart will be costly in time and money.

It is hypocritical to claim that water is one of our most precious resources if we fail to commit the resources needed to build an effective system for water quality management.

We must proceed systematically to build the information base for identification, evaluation, and control of toxic substances in the environment. Without this base our toxic pollution control programs will not meet the objectives of the Clean Water Act.

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Mr. SCHEUER. Thank you very much for your excellent testimony.

Now, Dr. Raymond C. Loehr, Professor of Engineering at Cornell University.

Dr. LOEHR. Thank you, Mr. Chairman. I appreciate the opportunity to summarize the detailed comments that I have submitted for the record.

I would like to address in the brief time available three items. First, the research and monitoring needs related to nonpoint sources of pollution and then the research and monitoring needs related to sewage sludge disposal, and the need for extramural research on water quality issues. First, permit me to address the research and monitoring needs related to nonpoint sources of pollution.

Until recently, nonpoint sources of pollution were considered as being natural, generally uncontrollable, and relatively small in magnitude when compared to point sources. Greater information in the last decade on the characteristics and magnitude of nonpoint sources has shown these assumptions to be incorrect in many river basins.

The available information indicates that nonpoint sources can provide greater contributions of contaminants than point sources, can contribute potentially large amounts of conventional and toxic pollutants, are ubiquitous and cannot be ignored.

As has been pointed out in other testimony this morning, one of the missing links in our current knowledge about water quality is the impact of the nonpoint sources on the water quality of the Nation. The remaining water quality problems that we have in this country should be resolved in a cost-effective manner. As part of this resolution, nonpoint source contributions and impacts must be identified to determine the degree of improvement that could result from any proposed level of point source control. Adequate data is needed so that actual loads to surface waters from nonpoint sources can be determined and statistically analyzed. With such analyses, background conditions and sources can be understood, frequencies of occurrence can be identified, water quality impacts can be assessed, the contribution and impact of various point and nonpoint sources can be compared, and rational water quality management decisions can be made.

While EPA has had research and monitoring programs related to the characterization and control of nonpoint sources, many of these programs are no longer in existence. In addition, there are indications that the remaining programs will cease to exist.

Nonpoint sources are part of the total system that affects the water quality of this Nation. What is needed is a better understanding of that total system. A fragmented approach that focuses only on parts of the system, such as only on the impact of point sources, would result if there was no nonpoint source research and monitoring program in EPA. Nonpoint source research and monitoring efforts should be seen as part of the overall water quality management program and not viewed as an unnecessary or isolated effort. EPA should have a continuing research and monitoring program related to rural and urban nonpoint sources of pollution, and I would like to put emphasis on the term "continuing" or "continuity." Many programs seem to have a roller coaster effort in the agency. Starts and stops do not permit us to have the continuity of information that allow us to look at trends over a long term.

Now let me turn to the research needs related to sewage sludge disposal. The development of environmentally sound methods of sewage sludge disposal is a continuing challenge. The treatment of wastewaters not only produces purified effluent but, as we have heard this morning, significant quantities of sludge. Each year approximately 6 million dry tons of sewage sludge are generated by the publicly owned wastewater treatment plants in the United States.

Most of this sludge contains organics, although one can find measurable quantities of metals, minerals, and industrial compounds that are invariably present. Sludge also may contain pathogenic organisms which survive the treatment processes. Improper sludge disposal can have an adverse impact on ground water and public health, can be the source of odors and nonpoint source problems, and can increase the costs of wastewater treatment.

Every municipality produces sludge. Every municipality must have it managed correctly and must pay the costs of that management. Sludge treatment and disposal costs at publicly owned treatment works can be nearly 50 percent of a plant's operating and amortized capital costs. If the results of sludge research and development projects could reduce the quantity of sludge ultimately requiring disposal and/or reduce the costs, a sizable impact could be made for the public.

The EPA sludge management research program is scheduled for reduced funding. Only about $1 million will be available for extramural sludge research in fiscal 1983, with the likelihood of even less in fiscal 1984.

There are many relevant research efforts that should be pursued. EPA itself has summarized many of these research needs in its research strategy document. In addition, the Water Pollution Control Federation, a group that I believe you will be hearing from later this week, has had a subcommittee analyzing sludge management research needs and has identified a number of these needs. Adequate support should be available from EPA for these and other sludge management research topics.

The last item I would like to address relates to the need for and support of extramural water quality research by EPA. Information from the Office of Management and Budget indicates that there may be a 54-percent decrease in the funds available to support water quality research. We heard Dr. Rohlich address that question in terms of dollars a minute ago. All extramural research in the water quality program is to be eliminated, shifting all future activities to in-house, in-house to EPA, research and development laboratories.

I submit that, without a better balance between internal and external research and development support by EPA, the diversity of talent, intelligence, and imagination that exists in private research organizations, academic institutions, and the private sector, will not be brought to bear on the Nation's current and emerging water quality concerns.

For example, if there is a decrease of $15 million in extramural water quality research, this will mean that the equivalent of about 150 fewer senior researchers and about 300-400 related personnel will not be working on water quality research. There should not be an elimination of extramural research in the EPA water quality program.

That concludes my remarks, and I would be pleased to try to answer any questions you may have.

[The prepared statement of Dr. Loehr follows:]

STATEMENT OF
DR. RAYMOND C. LOEHR
PRESENTED TO THE
SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT,
COMMITTEE ON SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

JUNE 8, 1982

INTRODUCTION

My name is Raymond C. Loehr. I am a professor of agricultural engineering and environmental engineering at Cornell University. In addition to my academic responsibilities, I have been a member of numerous professional committees that have evaluated the need for and quality of water quality related research. My research efforts over the past twenty years have focused on the development of technical solutions to municipal, agricultural, and industrial waste management problems. These efforts have included the use of land as a waste management alternative, the identification and control of rural non-point sources of pollution, and technologies to stabilize and dispose of agricultural wastes and sewage sludge. Separate sabbatic leaves of absence from Cornell University have been spent with the Environmental Protection Agency as an advisor with the Effluent Guidelines Division and with an environmental consulting firm. My comments reflect my professional judgement.

I would like to address the research and monitoring needs in two areas (a) non-point sources of pollution and, (b) sewage sludge disposal. In addition, I would like to comment on the need for extramural water quality research.

NON-POINT SOURCES OF POLLUTION

Historically, national water pollution abatement policies have focused on control of municipal and industrial point sources. Interest in other potential pollution sources has increased as the nation has realized that our water, air, and land resources should be viewed as an integrated system rather than as components isolated from each other.

Until recently non-point sources of pollution were considered as being natural, generally uncontrollable, and relatively small in magnitude compared to point sources. Greater information on the characteristics and magnitude of non-point sources have shown these assumptions to be incorrect in many river basins. A recent Congressional report (1) estimated that non-point sources contribute about half of all of the pollutants entering the nation's 246 river basins. Pollution from urban runoff was noted to equal or exceed the impact on water quality from point sources of pollution.

The major focus on non-point pollutants has been on oxygen demanding substances, sediment, and nutrients, i.e. conventional and non-conventional pollutants. Interest in the non-point contribution of metals and potentially toxic organic compounds, such as priority pollutants, has emerged only in the last few years. As a result, very little data is available on the contribution and water quality impact of potentially toxic compounds from non-point sources. Nonetheless, estimates relating to the Great Lakes indicate that, at least for metals, the non-point source contributions can be significant.

The relative contribution of heavy metal loadings from various point and non-point sources has been assessed by the Great Lakes Basin Commission (2). Metal loadings from urban and rural runoff from Wisconsin and Michigan, states which were able to provide the most complete information, were higher than the loadings from municipal or industrial point source loads.

Precipitation also can be considered a non-point source of contaminants. Only recently has an appreciation developed for the relative impact of atmospheric deposition of contaminants on water quality. The Science Advisory Board of the International Joint Commission supported two studies to estimate the atmospheric input of metals and organic substances to the Great Lakes (3). The resultant estimates represent first approximations but did indicate that atmospheric deposition of these substances could be non-trivial.

These brief comments on non-point sources are not meant to be comprehensive but to note that non-point sources of pollutants can not be ignored, can provide greater contributions of contaminants than point sources, can contribute potentially large amounts of toxic pollutants, and are ubiquitous. A missing link in the current knowledge about non-point pollutants is their ultimate fate in surface waters and their water quality impact.

Evidence on the quantities and characteristics of pollutants from non-point sources indicates that control of such sources of pollution is of continuing, long term interest in water quality management. Much remains to be learned about the dynamics of non-point pollutants and their water quality impacts. Shortcomings in the data base exist, especially related to the contribution of potentially toxic pollutants and to the efficacy of site specific best management practices (BMPS) to control such pollutants. Well conceived and designed research and monitoring programs, with adequate continuity, can identify the relative contribution of non-point sources, the relative need for controls, the types of controls that are most effective, and indicate where expenditures for construction, operation, and maintenance are not needed.

In the past, EPA has had research programs that focused on the control of both rural and urban non-point sources. With regard to rural sources, these programs have been theoretical and applied with the applied research involving both small size plots and large scale field demonstration efforts. Cooperative efforts with the U.S. Department of Agriculture have been effective. Much of the knowledge that currently exists on the contributions from rural non-point sources and on the appropriate BMPs for such sources has resulted from the EPA research and monitoring efforts.

At this time, EPA does not have a research and development effort related to rural non-point sources. A current monitoring effort exists as part of the rural clean water program activities. This effort will draw to a close shortly. Because non-point pollutants are generated from hydrogeologic events, non-point source monitoring needs continuity to measure the impact of these variable events on surface water quality and on groundwater quality.

Potential control of non-point sources can affect groundwater as well as surface waters. Non-point source controls minimize surface runoff. The water, however, which must go somewhere, will infiltrate into the soil, and therefore not only recharge subsurface waters but transport dissolved contaminants to the groundwater. The interrelationship between non-point source BMPs and groundwater quality needs evaluation.

Except for information on pesticides and other agricultural chemicals, very little data exists on the contribution of potentially toxic organic and inorganic pollutants from rural non-point sources. Knowledge about the magnitude and characteristics of these pollutants will be important as water quality management decisions are made.

In the urban runoff area over the past 15 years, EPA has had a sequence of studies on the characterization and control of stormwater discharge and combined sewer overflows. These studies have been supported by the EPA Office of Research and Development (ORD). The studies have identified the variability of urban runoff concentrations and have focused on conventional and nonconventional pollutants. Although some data exists on metals in urban runoff, much less data exists on the concentration of potentially toxic organic pollutants in urban runoff. The ORD efforts have not emphasized studies on receiving water impacts and effects of urban runoff.

In 1978, EPA initiated its Nationwide Urban Runoff Program (NURP) to build upon prior work and to provide additional, practical, consistent information to guide future policy and program development efforts. NURP is not a research program but rather is a practical, engineering approach. NURP data are taken and used in a planning context. The NURP efforts are part of the Water Planning Division of EPA.

A draft report summarizing the NURP program is available (4) and identifies the concentration of conventional, nonconventional, and priority pollutants in urban runoff. One of the products of the NURP efforts is a methodology to quantitatively define the water quality effects of pollutant loads from urban runoff. When available, the methodology will be able to be adopted to other non-point sources.

Twenty-eight NURP projects are underway and include one or more of the following: (a) characterizing pollutant types, loads, and effects on water quality, (b) determining the need for control, and (c) evaluating various alternatives for possible control of urban runoff. These three year projects are yielding valuable information pertinent to water quality management decisions.

While EPA has had research and monitoring programs related to the characterization and control of non-point sources, many of these programs are no longer in existence. In addition, there are indications that the remaining programs will cease to exist. For instance, the NURP monitoring efforts are scheduled to be phased out in FY 82 although data analysis efforts will continue. Approximately $19,000,000 has been spent on the 28 NURP projects over three years as well as about $5,000,000 by the U.S. Geological Survey and additional support provided by states.

If the loss of these efforts were to occur, it would be to the detriment of the nation's water quality management efforts. Continuity of effort and a better understanding of the magnitude of the problem, need for controls, the type of appropriate controls, and the cost of such controls is needed.

In considering additional non-point source research and monitoring needs, it is pertinent to note that non-point source contributions result from hydrologic events that are variable in time and space. However, these events are orderly, follow the laws of chance, and are amenable to statistical analysis. Lengthy records of precipitation events and stream and river flow are available in most parts of the country. Comparable data on the concentration of pollutants, especially potentially toxic pollutants, in such runoff is not yet available.

Adequate concentration data is needed so that the actual loads to surface waters can be determined and statistically analyzed. With such analyses (a) background conditions and sources can be understood, (b) frequencies of occurrence can be identified, (c) water quality impacts can be assessed, (d) the contribution and impact of various point and non-point sources can be compared, and (e) rational water quality management decisions can be made.

Any expenditures for water pollution control and water quality management must achieve measurable increases in water quality, protection of public health, or beneficial use of the waters. If this is to be accomplished, the effects of both point and non-point sources must be considered in a coherent quantitative manner. The relative water quality impact, possible need for controls, and the relative degree of control of each source must be determined if water quality management decisions are to be rational and cost effective. Without a continuing non-point source research and monitoring program, it will be impossible to develop cost effective decisions and to determine rational priorities in a time of competing demands on constrained resources.

Unfortunately, there is no obvious consituency interested in non-point sources nor is it a news catching, flashy technical or scientific topic. However, knowledge about the contribution of non-point sources is important to the nation's water quality management efforts and to rational decisions about the relative need for point and non-point source control. A better understanding is needed of the contribution and impact of all sources and of the type and cost of viable controls to be used where or if needed.

Remaining water quality problems should be resolved in a cost-effective manner. As part of this resolution, non-point source contributions and impacts must be identified to determine the degree of improvement that could result from any proposed level of point source control. At present, the capability to identify non-point source caused problems and trade-offs between point and non-point source controls does not exist in EPA. In addition, all work directed providing such a capability in EPA has been stopped.

Non-point sources are a part of the total water quality system. What is needed is a better understanding of that total system. A fragmented approach that only focuses on parts of the system would result if there were no non-point source research and monitoring program in EPA. There must be continuity of the research and monitoring efforts and these efforts should be seen as part of the overall water quality management program, and not viewed as an unnecessary, isolated effort.

The non-point source research and monitoring needs necessary to address the nation's water quality problems include:

- continuity of efforts in selected watersheds and cities to obtain statistically reliable concentration and loading data;
- information on the concentration of potentially toxic substances in rural and urban runoff;
- identification of the water quality impact of non-point source loads;
- detailed statistical analysis of existing and acquired data to identify relative frequencies of pollutant occurrence and the need for controls or best management practices
- developing a definitive comparison of the conventional, non-conventional, and toxic pollutant loads and impacts from municipal and industrial point sources, urban and rural non-point sources, and precipitation; and
- identifying relationships between rural non-point source controls and groundwater quality changes.

SEWAGE SLUDGE DISPOSAL

The development of environmentally sound methods of sewage sludge disposal is a continuing challenge. The treatment of wastewaters not only produces purified effluent but also a significant quantity of sludge. Each year approximately six million dry tons of sewage sludge are generated by the publicly owned wastewater treatment plants (POTWs) in the United States. The increased treatment requirements necessary to protect the nation's waters results in greater production of sludge.

Sludge generated from the treatment of municipal sewage primarily contains organics, although measurable quantities of metals, minerals and other compounds invariably are present. The sludge also may contain pathogenic organisms which survive the treatment processes. Where the wastewaters contain large amounts industrial and commercial wastes, the potential for toxic materials in the sludge is increased.

The disposal of sludge can affect the air, land, and water and requires consideration of human health, animal health, plant growth, nuisances, and protection of ground and surface water. Proper operation, maintenance, and monitoring of sludge utilization or disposal practices are essential to ensure that adverse environmental impacts do not occur.

Sludge is the inevitable product of our standard of living and our desire for a better environment. Sludge must be considered as a potential threat to the environment (negative impact) and as a potential resource that should be utilized (positive impact). Environmentally sound and economic methods of sludge disposal must be utilized. Research and monitoring is needed to develop new methods and improve currently used methods.

There are many sludge disposal options such as high temperature processes (incineration, co-combustion, starved air combustion, wet air oxidation), ocean disposal, and land application (composting, landfills, agricultural land). High temperature processes are not total disposal methods since a residue remains for subsequent disposal.

Each sludge disposal alternative has potential environmental impacts relating to one or more of the following: ground and surface water pollution, odors, contamination of the food chain, transmittal of pathogens, air pollution, ash disposal, and alteration of terrestrial and benthic communities. The fact that there can be a number of adverse environmental impacts is less relevant than the relative risk associated with the impacts. There is no hope of reducing all adverse impacts and risks to zero.

Because safety is a judgemental decision, a sludge disposal option such as land application or incineration will be judged safe if its risks are acceptable to the public. Whether something is "safe" can not be measured. The physical and biological sciences can assess only the probabilities and consequences of events, not their value to people.

The many concerns about acceptable risk can be summarized by several basic considerations:

- definition of conditions of exposure, i.e., who or what will be exposed? to what? in what way? for how long?
- identification of adverse effects, i.e., what is the threat or adverse effect to the individuals or objects that are exposed?
- relationship of exposure with effect, i.e., how much adverse effect results from how much exposure?
- is the risk assumed voluntarily or involuntarily?
- are the consequences reversible or irreversible?

These considerations should be taken into account in judging the relative risks and adverse environmental impacts of sludge disposal methods. Identification of these risks and impacts is a continuing sludge disposal research need.

The quantities of sludge are increasing and the problems associated with its disposal will not go away. The costs attributable to sludge management (handling, stabilization and disposal) at a wastewater treatment plant represent an appreciable fraction of the overall costs of wastewater management. Research continues to be needed to reduce these costs, to better understand the stabilization and detoxification mechanisms that occur in sludge stabilization and disposal processes, to better control the performance of these processes and to develop sludge disposal approaches which are environmentally sound, economically feasible, and publicly acceptable.

EPA has had a separate sludge treatment and disposal research program for about five years, although sludge research has been conducted by EPA for a longer period of time. As necessary, the focus of this program has changed in response to perceived needs and opportunities. For example, changes in the economy and cost of fuel have resulted in research on less costly and energy intensive sludge disposal processes. Emerging needs, new ideas, and changes in the economy can require continued research, but with a different emphasis, on a specific process.

Funds from a number of EPA sources support sludge management research: the engineering and technology program, the health effects program, and the ocean disposal program. The maximum annual level of support for sludge treatment and disposal research by the engineering and technology program was about $3,500,000 in FY 79. Of this amount, about two-thirds was used to support extramural research. In addition, about 1 to 1.5 million dollars has been spent in recent years from the health effects program budget on sludge treatment and disposal research. Such research focused on epidemiological studies. Approximately $650,000 has been available from ORD, $600,000 from the EPA program office and $600,000 from the Corps of Engineers for research on the ocean disposal of sludge. During the period of 1977 through 1981, research related to ocean dumping was not supported by EPA.

The EPA program has been coordinated with and at times supported research and needed studies by the U.S. Department of Agriculture, the Food and Drug Administration and other governmental agencies. This multi-agency involvement has been both desirable and effective.

The EPA sludge management research program is scheduled for reduced funding. Only about $1,000,000 will be available for extramural sludge management research in FY 1983 with the likelihood of even less in FY 84. Additional sludge management research can be conducted by EPA personnel. With the present staff, EPA could handle about $3,500,000 of extramural research funds in the engineering and technology program and about $3,000,000 in the ocean disposal program. To almost eliminate the amount of funding for sludge management research when there are many important unresolved technical, scientific, health, and economic issues would be a disservice to the nation and ultimately could have an adverse impact on the resolution to the nation's water quality problems.

The multi-media aspects of water pollution control efforts must be recognized and adequately included in research funding. Improper sludge disposal can have an adverse impact on groundwater and on public health, can be the source of odors and non-point source pollutant problems, and can increase the costs of wastewater treatment and therefore the costs to the public.

Every municipality produces sludge, must have it managed correctly, and must pay the costs of that management. Sludge treatment and disposal costs at publicly owned treatment works frequently can be nearly 50% of the plant operating and amortized capital costs. If results from sludge research and development projects could reduce the quantity of sludge ultimately requiring disposal and/or could reduce these costs, a sizable impact could be made.

It is inappropriate to rely primarily on intramural EPA sludge management research since such an approach will limit new ideas. If only about $1,000,000 is available for extramural research in FY 1983, only continuations of existing projects are likely to be funded. No new sludge management research may be funded.

There are many relevant research efforts that should be pursued. EPA has summarized some of these research needs in its research strategy document (5). In addition, the Water Pollution Control Federation has had a subcommittee analyzing the sludge management research needs. The subcommittee members are from industry, academia, federal agencies, consulting engineering firms, and a large municipality. The subcommittee report is comprehensive , balanced and categorizes many detailed research needs (6). The following are illustrative of the major sewage sludge disposal research needs identified in these documents:

- evaluate factors contributing to cost, energy consumption, and pollutant discharges from alternative types of sludge combustion;
- develop means to detoxify sludges;
- understand the transformations, plant uptake, and ultimate fate of pathogens, synthetic organics, and metals in sludge which is applied to land;
- evaluate the fate of sludge constitutents in landfills and develop necessary control technology;

- establish the fate and effects of sludge constituents in the ocean through studies that involve careful mass balance calculations; and
- develop relative risk assessment methodologies that permit rational decisions on alternative means of sludge management.

Descriptions of other desirable research efforts are included in these documents.

I concur with the research recommendations in these documents and would add that adequate support should be available from EPA for many of the research topics. As a minimum, the EPA extramural sludge research program should be approximately $3,500,000 per year. This level of support would permit funding of a number of new projects each year and is consistent with the availability of EPA personnel to monitor such a program.

EXTRAMURAL RESEARCH EFFORTS

The Office of Management and Budget (7) has proposed the following budgetary impact on the EPA research and development program:

> "The water quality research program expects to obligate $13 million in 1983, a decrease of $15 million from the 1982 level. In the municipal wastewater program, activities that are more appropriately conducted by the private engineering community, such as design engineering, are being eliminated. All extramural research in the water quality program will be eliminated, shifting all future activities to in-house R & D labs. The engineering-related extramural research of the industrial wastewater program is being reduced, due to near completing of the effluent limitations effort." (Underlining added).

If the proposed reduction of funds (a decrease of 54%) and the elimination of extramural research occurs, a severe blow will be dealt to water quality research. With both actions, a clear signal will be sent indicating water quality problems are not a serious issue in the nation and that very little future research is needed. The signal will cause competent researchers to focus on other problems.

Without a better balance between internal and external research and development support by EPA, the diversity of talent, intelligence, and imagination that exists in private research organizations, academic institutions, and the private sector will not be brought to bear on the nation's current and emerging water quality concerns. In addition, the non-point source and sewage sludge research and monitoring needs identified earlier will not be addressed. There also is an urgent need for scientific data to support water quality criteria and state water quality standards and for improvement of the performance of publicly owned treatment works, especially related to the removal of potentially toxic pollutants.

As qualified as EPA researchers are, no agency can contain all of the wisdom and insight on a topic. Progress results from diversity of ideas, sharpening of questions, and evaluations from different perspectives. The strength and success of a research effort results from such diversity, questions and evaluations. Diversity and strength comes from extramural support of research and peer review critique of submitted proposals.

The near zero support of research in certain areas is inappropriate for reasons such as those noted above and because there will be a loss of qualified extramural researchers. For example, if there is a decrease of $15 million for water quality research, this will mean that the equivalent of about 150 fewer senior researchers and about 300 -400 technicians, students, and related personnel will not be working on water quality related research. A continuing flow of new ideas and a base of quality external research is important to the solution of water quality related problems.

To sustain the research efforts needed for resolution of the nation's water quality problems:

- the EPA water quality research program should have a budget approximately the same that it had in FY 82 and preferably be increased;
- there should be a better balance between internally and externally supported EPA research, development and monitoring efforts; and
- there should not be an elimination of extramural research in the EPA water quality program.

SUMMARY

In conclusion, there are many research needs related to current and emerging problems in the areas of non-point sources of pollution and sewage sludge disposal. Continuity of the existing programs is critical and funding for the EPA programs in these areas should at least be kept at FY 82 levels but preferably should be increased. In addition, there should be no elimination of extramural water quality research support.

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Mr. Scheuer. Thank you very much, Dr. Loehr.

Dr. Rohlich, I would like to ask you, as a member of the Science Advisory Board, what your view is as to the current research program of EPA, as to the effect of the various changes that they have carried out and implemented, and that they contemplate as represented in their legislative funding request. And third, your view as to the effectiveness of the Science Advisory Board in having a practical effect on the R&D policy of EPA.

Dr. Rohlich. Thank you, Mr. Chairman.

I might say that the membership on the Science Advisory Board is only a few months old and we have had just one meeting. I chair the committee on environmental engineering of the Science Advisory Board, and I am also serving on the executive committee because of that chairmanship.

Our discussion at this first meeting has been related particularly to the question of the background information for the effluent limitation, guidelines, and limitations for the organic chemicals industry. We have just been studying that material. So I don't have anything really to report to you other than what would be my personal opinions, rather than the opinions of the committee.

Mr. Scheuer. I would welcome them. On those questions I have asked, I would welcome your personal opinion.

Dr. Rohlich. Well, with regard to the last part of the question that you asked, we were assured by Dr. Hernandez that they were particularly interested in the input from the Science Advisory Board and that they were particularly interested in the questions that you have referred to in terms of accepting the Science Advisory Board's recommendations with regard to the scientific background necessary for development of regulations and for other activities. So I feel confident at this point that the Science Advisory Board's input will be given serious consideration by Dr. Hernandez.

Now, as to the effectiveness of the program with the budget cuts, I think my testimony points out that I have serious concern as to whether there will be the kind of pruning that is necessary that may, in fact, destroy a part of the growth, because I think the pruning will have to be very severe and the priority establishment done with great care if there is to be benefit obtained from the research programs.

Mr. SCHEUER. Dr. Rohlich, we have just received today EPA's research outlook for 1982——

Dr. ROHLICH. That I haven't seen. I have seen the 1980 and 1981, but I haven't seen this yet.

Mr. SCHEUER. You didn't have a chance to see this report before it was circulated to the Congress?

Dr. ROHLICH. I don't recall receiving it.

Mr. SCHEUER. I see. Well, let me read the letter of transmittal. This is addressed to Congressman William Carney, ranking minority member of the Subcommittee on Natural Resources, Agriculture Research and Environment.

> I am pleased to transmit to you the research outlook for 1982 which describes the EPA's 5-year plan for research, development and demonstration. This report is prepared annually in response to section 5 of Public Law 94-475—

Which incidentally was due within 2 weeks of the time they submitted their budget request in February.

> The report has been submitted to the Agency's Science Advisory Board for review. Their comments, along with my response to these comments, will be submitted to you shortly as required by section 8(c) of Public Law 95-155. Sincerely, Ann Gorsuch.

So, apparently it was submitted to the Science Advisory Board at the same time it was submitted to Congress, so it does not reflect your views. We would be interested in hearing your views and probably in the course of our oversight hearings it is quite likely that we will be asking you back again to testify on that plan.

Dr. ROHLICH. I would be pleased to do so.

Mr. SCHEUER. It seems to me that this might have been more use to us if at the same time we got this we were able to get your informed thoughts about it, or even better, for you to have had a role, to have had input in developing the research outlook for 1982. It seems to me, rather than simply responding to a fait accompli, so to speak, a more creative and more thoughtful role for your Science Advisory Board might have been to participate in the take off rather than to comment a potential crash landing.

But, be that as it may, this is the situation of what prevails, or as Grover Cleveland said a century ago, "We are faced with a condition and not a theory." The condition is that your opinion is being sought after the fact. We will still be very much interested in hearing your views. As I said, in the course of our oversight activities, it is more than likely that we will be soliciting your views.

Dr. Moore, I am going to ask you sort of a double-pronged question. What impact do you feel the Clean Water Act of 1977 has had on the control of toxic pollutants, and has the technology base standards advocated by the 1972 amendments constituted an improvement in efforts to monitor water quality?

Mr. MOORE. Mr. Chairman, if I may, first of all, in deference to the distinguished colleagues on this panel, I would like to say that I am one of those who sneaked into academia without the Ph. D. degree, so I am not "Dr." Moore, but "Mr." or "Professor."

Mr. SCHEUER. OK.

Mr. MOORE. I insisted upon full rank and tenure, and so, once in, they can't get me out, unless, of course, I am guilty of moral turpitude of some kind, and I hope I avoid that.

I need to say a couple of things with regard to where we now stand as a result of the 1977 amendments. This peculiar dichotomy that arose in the 1977 act, that now characterizes some pollutants as "toxic" and some as "conventional," arose because of a shorthand system of communication that was developed within the staff of the National Commission on Water Quality, where we came to call the traditional pollutants "conventional" in order to make a distinction between those and other pollutants.

I think it was unfortuntate that BAT, "best available technology economically achievable," was transferred as the control mechanism for toxics and a new mechanism defined as "best conventional pollutant control technology" was written into the 1977 act. I will come back to that in just a moment.

With regard to the shift from a water quality standards based national water pollution control program to a technology-based water pollution control program in the 1972 amendments, I have no objection to that and had no objection to it at the time, except what I still regard as a very practical consideration, which the Environmental Protection Agency eventually confronted. The enormous number of individual discharges in this Nation cannot be permitted by the bureaucracy out of Washington, D.C. We did not know then how many would have to be permitted and, quite frankly, we still don't know exactly how many are supposed to be permitted under the 1972 amendments, because the process thus far has been largely voluntary by the permit applicant.

I felt that the 1972 act, in its focus upon a major Federal role, would impose a burden upon the administering agency that could possibly never be adequately funded by the Congress, and I think that the last 10 years have demonstrated and the agency has learned, that it cannot administer that program under that law exclusively by a bureaucracy fundamentally based in Washington, D.C.

But I have no objection to the technology based approach. In fact, the Texas program prior to the 1972 act had a technology base, and we issued permits on the basis of technological considerations.

Now, with regard to BAT, best available technology economically achievable, the National Commission's staff recommendation to the Commission was that the deadline be postponed 5 years, from 1983 to 1988. I still think that would have been a better solution than introducing BAT as a toxic control technology. I don't think we have realized the requirement of the 1972 act for BAT for toxics control. If anything, shifting the statute to that base may have delayed to some degree toxics control.

I am emphatic on one point. I think it would be a tragic mistake for the Congress to authorize any system at this juncture that would allow waivers of BAT, so long as BAT is the device for toxic control. I think that would be a tragic mistake.

The technology for toxics control—so long as we know as little as we do about toxics, I think it is important that the statute remain as it is. Unfortunately, in periods of uncertainty, it is better to have a stronger statutory base than it is when the uncertainty is resolved. Some disagree with that, but I frankly feel that is the thrust we should take and I would urge the Congress not to authorize any system of waivers for BAT. I think we should proceed with BAT as rapidly as possible, and the agency should be encouraged to issue the necessary technology-based effluent limitations for BAT.

I might just comment on one other thing. With regard to pretreatment—and I have consistently held this view, and it has not been the one followed by the Agency—I think it was a mistake for the Environmental Protection Agency to originally establish the pretreatment requirements at a level equivalent to BAT, even prior to the 1977 amendments. The concept of pretreatment clearly stated in the statute was to protect a waste water treatment plant, a municipal waste water treatment plant receiving industrial effluents from damage to the treatment process, or to prevent the passage through the treatment process of pollutants that would not be removed. I contend that the pretreatment program should have been something less than what EPA has consistently proposed for 10 years, and I think the difficulty with pretreatment now exists because the Agency started on the wrong course to begin with. I think the Agency should be required to return to what was the clear intent of the statute, that pretreatment be designed to prevent the passage of undesirable pollutants through a municipal waste water treatment plant, or to eliminate pollutants that would destroy the treatment process.

Mr. **Scheuer**. Thank you very much, Professor Moore.

Dr. Loehr, let me ask you, you stated in your testimony that nonpoint sources account for about half of this Nation's total water pollution.

What effect will the proposed Federal funding cuts and terminations in nonpoint water pollution abatement programs have on long-term water quality in the United States? And following this flow of thought, are nonpoint source pollution problems expected to increase or decrease over the next 5 to 10 years?

Dr. **Loehr**. Let me attempt to address the latter part of that question first.

As we have continuing success with the point source program through total implementation of BPT for industry and secondary POTW controls, and, as appropriate, use of BAT regulations where they can be identified, we will see that the nonpoint source problems will loom larger in the future because they are the sources that will remain. As one reduces one source of input of pollutants to our Nation's waters, those remaining become more obvious. We need to know more about that. The magnitude and impact of nonpoint sources of contaminants.

Now let me address the first part of the question. As I stated in my testimony, I firmly believe that EPA needs continuity and a long-term research and monitoring program related to the nonpoint source issues so that we can answer questions relating to the overall water quality problems in the United States:

What are the problems? What are the sources of those particular problems? What amounts are being contributed from the various sources? What are the impacts of those sources entering the waters? What is the fate of the material that is? and, what the proper controls for those point sources and nonpoint sources? The dollars that are being cut from this program will hamper that effort. Without a nonpoint program, it is like having blinders on and only looking at one particular aspect of the inputs to the waters of the United States. Such blinders will ultimately cause us not to make some of the better decisions with regard to proper controls. This will be to the detriment of the water quality management efforts of the United States. If we do not have a nonpoint source program, we will not really be able to know the most appropriate solutions to some of our water quality problems.

For instance, the nationwide urban runoff program, which is now managed out of the Water Quality Program Office, is for the first time getting interesting and potentially useful information on toxics in urban runoff. That program, is now being cut. As a result, we will know very little about the level of toxics in the urban runoff entering the waters of the United States.

Mr. MOORE. Mr. Chairman, if I may, I would like to reinforce what Dr. Loehr has said with regard to nonpoint pollution contributions to the Nation's waters.

One of the arguments advanced by industry—and some municipalities, by the way—during the course of the work of the National Commission on Water Quality, was that it was nonpoint sources that were contributing the major problems to the quality of the Nation's waters, and until that contribution was adequately analyzed and characterized and quantified, efforts for point source pollution should be postponed. And until there is an adequate definition of the contribution of nonpoint source pollution, and the quantities that are being contributed from the various sources, the Congress and the Administrator of this statute will be confronted with that type of issue. There will have to be a resolution of the degree of pollution caused by nonpoint sources, both urban and rural.

Mr. SCHEUER. Thank you very much. I want to thank this panel for its very excellent testimony. You have given us a great deal to chew over and I am sure we will benefit from your testimony.

I am also sure we will have some further written questions for you in the next week or 10 days. We will hold the record open for what we hope will be your timely responses.

Again, thank you very much for your fine testimony.

Mr. SCHEUER. We will now hear from the last witness today, Russell Langford, Associate Chief Hydrologist, Water Resources Division of the U.S. Geological Survey.

Mr. Langford, we are running a little behind. We have read your excellent 33-page testimony, that was chock full of very thoughtful and insightful comments. So we would very much like you to sum up in 6 or 7 minutes. We will have time for some questions, I am sure. Of course, your full testimony will be printed at this point in the record.

STATEMENT OF RUSSELL H. LANGFORD, ASSOCIATE CHIEF HYDROLOGIST, U.S. GEOLOGICAL SURVEY, ACCOMPANIED BY R. J. PICKERING, CHIEF, BRANCH OF QUALITY OF WATER; AND JOHN B. ROBERTSON, CHIEF, OFFICE OF HAZARDOUS WASTE HYDROLOGY

Mr. LANGFORD. Thank you very much, Mr. Chairman.

I have taken the liberty of asking two of my colleagues to be here with me, both of whom are deeply involved in our studies of surface water quality and ground water quality.

Mr. SCHEUER. Would you invite them up to sit with you and introduce them for the record?

Mr. LANGFORD. I will. Thank you, sir.

This is Dr. R. J. Pickering, who is Chief of our Branch of Quality of Water, and Mr. John B. Robertson, who heads up and is Chief of our Office of Hazardous Waste Hydrology.

Mr. SCHEUER. We are very happy to have them both here.

Mr. LANGFORD. We represent an organization, as you probably know, Mr. Chairman, that has no regulatory responsibility, no development responsibility, but does have a responsibility for assessing the water resources of the Nation. My remarks will deal with those studies that we have underway on that point.

Mr. SCHEUER. Very good.

Mr. LANGFORD. Now, with regard to surface water quality, we, of course, conduct these studies at various levels of detail. My remarks will be primarily focusing on two principal monitoring networks the Geological Survey operates. These two networks address the water quality conditions in the Nation's rivers on a uniform and consistent basis in terms of the coverage of parameters measured, the frequency of sampling, and the methodology by which the analyses of water samples are made and interpreted.

These two networks are the Hydrologic Benchmark Network, which began in the midsixties, and the National Stream Quality Accounting Network, which began about 1973. These dots on this national map depict these two networks, on the one hand the large dots—representing the Hydrologic Benchmark Network—show about 50 places around the country where, in essence, the quality of rivers draining areas, usually small basins, unaffected by the activities of man, are measured. The small dots—representing the National Stream Quality Accounting Network—show about 500 places around the country where the major rivers are monitored on a uniform, nationally consistent basis.

Within just this past month the Geological Survey has published a detailed report on phosphorus trends in the National Accounting Network. Special statistical techniques had to be developed for detecting time trends in the water quality data of this network. This particular report is the first of an intended long series of products devoted to statistical studies of the data collected in the two networks.

The second panel depicts an illustration from the report on phosphorus which indicates where concentrations are increasing the upward trending arrows—decreasing, or remaining the same, at the black dots. The map shows rather widespread downtrends in phosphorus levels over the latter 1970's, except for that area indicated in red in the central part of the country. The fact that many of the rivers showing increases in phosphorus drain areas that are largely agricultural suggests that nonpoint sources contribute a major part of phosphorus in certain regions.

The statistical procedures applied to the analyses of phosphorus data are being applied to the entire NASQAN-Benchmark data base. A comprehensive statistical summary covering other water quality characteristics, including toxic trace metals and pesticides, is now in preparation. Within a year, several reports will be available. In addition, analyses have been made to determine the frequency of violation of EPA and State water quality standards for domestic water supply and fresh water aquatic life.

For example, this third panel shows where chromium concentrations have exceeded the drinking water standard in more than 10 percent of the samples collected as part of this network. These are the points depicted in red and yellow on the diagram.

As with many of the toxic trace metals, the occurrence of significant chromium concentrations in river water tends to be greater in the West than in the East. Undoubtedly, this geographic pattern reflects both the natural geologic occurrence of chromium as well as the location of human activities which introduce chromium into rivers. These data do not indicate why chromium levels are higher or lower at certain locations than for others, but simply the apparent fact that they are.

The fourth panel summarizes frequency of exceeding data for some other toxic substances. In much of the country, public water supplies are drawn from the ground water resource rather than from rivers or streams. Thus, the comparison here to drinking water standards is only to provide a guide to environmentally relevant levels of these various substances.

When all of this information is analyzed and reports published, what will we have? Well, we will know for the Nation's rivers the concentration levels and trends for about 35 water quality parameters, of which about 20 are identified as being toxic——

Mr. SCHEUER. I wonder whether we could go from the sublime to the ridiculous, or from the macro view to the micro view, and if you could tell me what has been the change for the Hudson River and what has been the change, if any, for Jamaica Bay, which I represent?

Mr. LANGFORD. Mr. Chairman, for the Hudson River, I can provide that information for the record. I do not have it here.

For Jamaica Bay, I will attempt to provide it. I do not know whether those data are a part of this network or not.

Mr. SCHEUER. And for the Potomac, if you will.

Mr. LANGFORD. And for the Potomac, I can provide that for the record, sir.

Mr. SCHEUER. Rumor has it that both the Potomac and the Hudson River are within 2 or 3 or 4 years of being swimmable. That would be very encouraging news for all of us.

Mr. LANGFORD. Yes, sir.

We are conducting studies, incidentally, on the Hudson addressing the problem of contamination by PCB's in the upper Hudson. Those data are available also.

Mr. SCHEUER. We would appreciate that.

Please continue.

Mr. LANGFORD. From all of this work we will know in general the areas where agencies should be concerned about the levels of toxic substances and where it appears that there is no major concern warranted. We will be able to alert EPA and other Federal agencies, State and local agencies, as to the specific locations, as well as the broad geographical areas where studies to determine the cause of the elevated and/or increasing trends in concentrations of key constituents should be considered further.

Now, as to ground water quality, unlike the NASQAN system or the benchmark system, which I have described, wherein surface waters can be relatively easily monitored to provide information about regional changes in water quality, a national network for ground water monitoring would be a costly and ineffective method of evaluating the status of ground water contamination. Ground water velocities are usually very low, and pollution of ground water tends to occur in slowly developing pockets around point sources of contamination, or in shallow, slowly expanding zones beneath areas of nonpoint pollution.

Because of the nature of the emplacement process, the actual volumes of contaminated ground water tend to remain small for long periods of time, in comparison to the total volume of ground water circulating in the area. Monitoring efforts without prior analysis and interpretation of ground water conditions is virtually guaranteed to fail, if for no other reason than that the directions of flow away from a contaminant source must be understood before an efficient monitoring program can be designed.

The alternative strategy is to study areas where point and nonpoint sources of pollution are known or are suspected to be affecting ground water quality. This is the approach which the Geological Survey has taken in virtually all of its work related to ground water contamination, involving both toxic and nontoxic wastes. The approach is to study the hydrologic and geochemical processes affecting the movement of water and its constituents in different hydrologic settings in order to develop the scientific know-how needed for effectively and efficiently predicting contaminant movement and fate.

From all of our studies, we estimate that less than 1 percent——

Mr. SCHEUER. Excuse me, Mr. Langford. What we want to know is, is water getting better or worse. You're getting a little bit technical for us.

Mr. LANGFORD. All right, sir.

Mr. SCHEUER. What is happening to the actual water quality of this country and what can we do to enhance it; what can we do to move matters forward and make progress; what is the effect of this administration's initiatives on the long-term effort to improve water quality? If you could of zero in your testimony and thinking to address these issues, it would be very helpful.

Mr. LANGFORD. Let me describe and conclude by commenting on the ground water contamination hazardous waste program. As I mentioned, we feel that about 1 percent or thereabouts of the total volume of usable ground water has been contaminated. We have recently initiated a hazardous waste ground water contamination program, having three major elements:

First, is an appraisal of existing ground water quality in each State, something that is not available at the present time.

The second is studies to develop the understanding of geologic and hydrologic processes that control the behavior and fate of contaminants in ground water.

The third is identification of areas potentially suitable for the storage of hazardous waste. This third element will be done in cooperation with the States and will involve identification of several specific hydrologic environments within each State that are most preferable for waste disposal within that State, as well as defining geologic and hydrologic guideline criteria for site selection.

The overall hazardous waste-ground water contamination program is funded this year at a level of about $1 million, our budget for 1983 calls for an increase of about $3½ million.

This should indicate, Mr. Chairman, that the degree of knowledge about toxics and chemicals in the ground water system is sparse, and that this program is aimed at getting a handle on that. The research element of it is aimed at developing an improved understanding of how these substances enter the ground water reservoir, and how they move through the ground water reservoir to streams or to points of discharge. We think this program addresses the issues that you raised with regard to ground water quality.

Where do we go from here? We are, as I've noted, continually evaluating our programs in the light of these changing needs for water information. Because of the study I mentioned on water quality information of surface waters, we feel that some changes are in order. We need to increase the number of priority pollutants which we analyze for in our programs. We need to change the focus of attention on pesticides and herbicides measured, to reflect the changing patterns of use of these substances in the country.

With regard to detection limits, we need to conduct research to develop new analytical techniques, with lower detection limits, for important contaminants. In terms of field operations, we need to locate more of the sampling stations on the smaller streams and rivers to achieve a more comprehensive picture of water quality, and we need to reduce the sampling frequency at some of those stations which have been in the network for long periods of time and for which concentrations are not showing any trends one way or the other.

The big issues in the area of ground water contamination, the ones that we are addressing, are first of all what are the physical, chemical, and biological processes that affect the migration and fate of contaminants; second, what geologic and hydrologic criteria are appropriate for selecting geographic areas suitable for disposal of chemical and radioactive toxic substances; and third, under what circumstances, if any, is it technically feasible and economically practical to actually restore contaminated ground waters.

Basic research is needed on the fate of volatile organic substances in water; on better definition of the absorption and desorption mechanisms of organic compounds and metals involving mineral or rock surfaces; and on a better definition of the role of microbial processes in the alteration of toxic chemicals.

In summary, a sizable part of our program is dedicated to evaluating issues for which the Clean Water Act and related acts were enacted to address. We cooperate with a wide range of Federal, State, and local agencies in providing data and technical expertise to aid in addressing and solving toxic waste problems, among others. We intend to continue to provide that support and the results of our work to meet the Nation's needs.

[The prepared statement of Mr. Langford follows:]

Statement of Russell H. Langford, Associate Chief Hydrologist, United States Geological Survey before the Subcommittee on Natural Resources, Agriculture Research and Environment of the Committee on Science and Technology, U.S. House of Representatives.

June 8, 1982

THE GEOLOGICAL SURVEY'S PROGRAM FOR DETERMINING THE STATUS OF THE NATION'S WATER QUALITY

INTRODUCTION

The U.S. Geological Survey's (USGS) water-resources program is a balance of data collection and dissemination, problem-oriented water-resource appraisals (interpretive studies), and applied and basic research. In this statement, I will describe the water-quality aspects of the program, emphasizing those elements dedicated to determining the status of toxic substances in surface and ground water. As background, I will briefly describe the organizational structure and operation of USGS's Water Resources Division (WRD), which has responsibility for the Geological Survey's water functions.

THE WATER RESOURCES PROGRAM

Mission

The mission of USGS's water-resources program is to provide the hydrologic information and understanding needed for the best use and management of the Nation's water resources.

To accomplish its mission, the Survey's Water Resources Division in cooperation with State, local, and Federal agencies--

- Collects data on a systematic basis to determine the quantity, quality, and use of the Nation's surface and ground water.

- Conducts interpretive water-resource appraisals to predict the consequences of alternative plans for developing land and water resources.
- Conducts supportive basic and problem-oriented research in hydraulics, hydrology, and related fields.
- Develops information on water-related natural hazards such as floods, droughts, volcanoes, mudflows, and land subsidence.
- Coordinates water-data acquisition activities of all Federal agencies.

Organization

The Water Resources Division is primarily a field organization. General direction of the Division's program is through four Regional Hydrologists located at Reston, Virginia; Atlanta, Georgia; Lakewood (Denver), Colorado; and Menlo Park, California. The four Regions consist of a total of 46 District Offices which generally are located in State capitals (Figure 1). Each District is headed by a District Chief who is responsible for the planning, programing, and implementation of water-resources investigations within the District.

Research projects support the Division's mission through study of the physical, chemical, and biological processes that affect the movement and quality of water in the hydrologic cycle. Research is conducted at three of the four regional centers and at project offices in other locations as needed.

The Geological Survey conducts its water-quality analyses in two highly instrumented laboratories in Denver and Atlanta. In 1981, the two laboratories analyzed more than 70,000 individual samples of water.

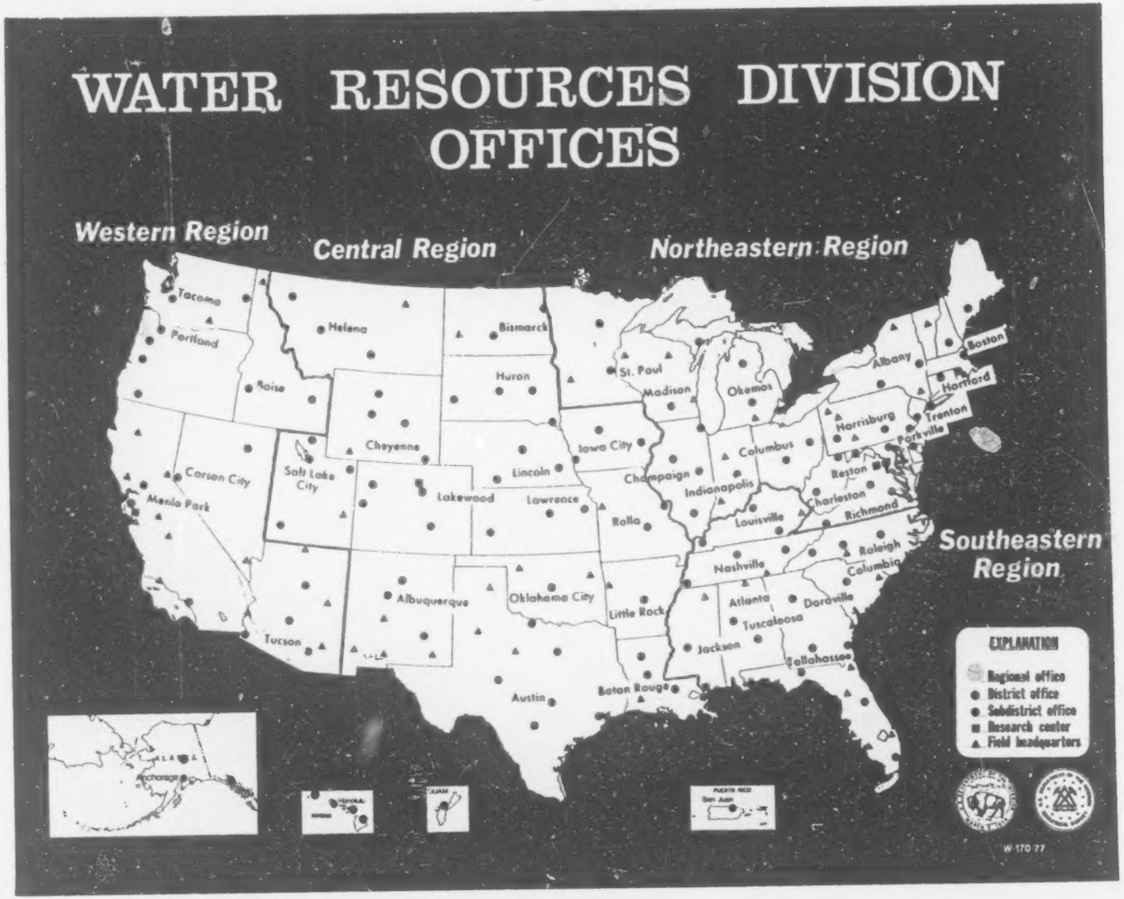

WATER RESOURCES DIVISION
OFFICES
Western Region
Central Region
Northeastern Region
Southeastern Region
Tacoma
Portland
Boise
Helena
Carson City
Menlo Park
Salt Lake City
Cheyenne
Tucson
Albuquerque
Lakewood
Bismarck
Huron
Lincoln
Lawrence
Oklahoma City
Austin
St. Paul
Madison
Iowa City
Champaign
Rolla
Little Rock
Baton Rouge
Jackson
Okemos
Indianapolis
Columbus
Louisville
Nashville
Atlanta
Tuscaloosa
Doraville
Tallahassee
Columbia
Raleigh
Richmond
Charleston
Reston
Harrisburg
Parkville
Trenton
Hartford
Albany
Boston
ALASKA
Anchorage
HAWAII
Honolulu
GUAM
PUERTO RICO
San Juan
EXPLANATION
Regional office
● District office
● Subdistrict office
■ Research center
▲ Field headquarters
W 170 77

Figure 1.--Office locations of the U.S. Geological Survey's Water Resources Division.

Sources of Funds

The Water Resources Division's programs are funded as follows (Figure 2): (1) the Federal program, which is specifically identified in the annual Geological Survey appropriations; (2) the Federal-State Cooperative Program, in which the Division represents national interests, the cooperating agencies represent State and local interests, and the funding is shared 50/50; with the Federal share coming from direct Congressional appropriations; and (3) the Other Federal Agencies (OFA) Program, which is funded by the agencies that request the work.

The Federal-State Cooperative Program is a unique partnership for water-resources investigations between the USGS and State and local agencies. This program is the foundation of much of the water-resources management and planning activity in the Nation, and it serves as an early-warning system for the detection of emerging water problems. The Cooperative Program is active in all 50 States, Puerto Rico, Virgin Islands, Guam, and the Trust Territories, and in 1982, there are agreements with more than 800 State and local agencies, at a total funding of more than $80 million. Because USGS performs most of the work, the program leads to a uniform and comparable national water information base.

THE USGS WATER QUALITY PROGRAM

The water-quality program of the USGS consists of three major components: (1) collection of basic data to describe the quality of surface and ground water, (2) research to increase knowledge of the processes which create the natural quality of water and which control the nature and rate of changes in water quality that result from anthropogenic point and nonpoint sources, and (3) applied interpretive studies to determine the causes of specific observed changes in water quality and to predict the nature and rate of

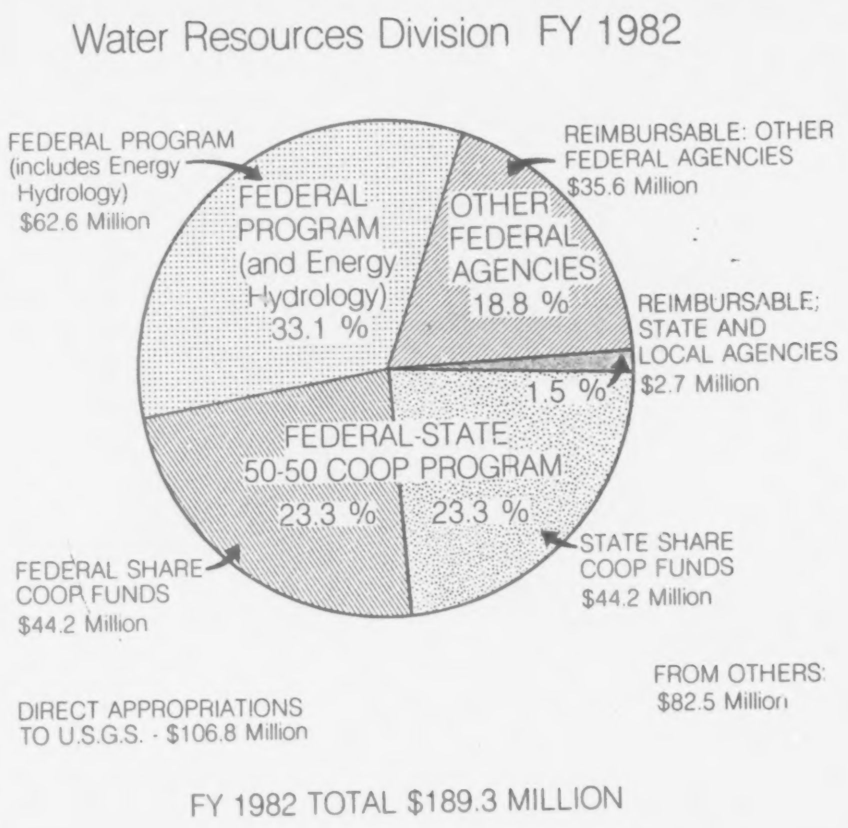


Figure 2.--Sources of funds for the U.S. Geological Survey's Water Resources Division, 1982 FY.

future changes that are likely to occur from use of surface- and ground-water resources. The three components are closely interrelated and interacting. For example, theories arising from water-quality research are the foundation for designing our data collection networks and for detecting trends that may exist in the quality of our water resources. Moreover, today's research results form part of the foundation for next year's interpretative studies. In a similar manner, data collection is a major component of all interpretive studies and most research. The following discussion of trend detection (pg. 12) through use of our surface-water quality networks illustrates how the USGS uses its basic data to plan and conduct interpretive and research studies.

Water-quality studies comprise a major part of the USGS water-resource program. For example, 870 out of a total of 1,500 water-resource investigations conducted by the Survey this fiscal year contain a water-quality component. Another way of emphasizing the importance of water quality studies within USGS is that in FY 1982, water-quality investigations amount to nearly $76 million or 40 percent of the total Water Resources Division funding of approximately $189 million.

Of the total water-quality program of USGS, a considerable part is responsive to the information needs of the Clean Water Act (P.L. 95-217). For FY 1981, USGS estimates that it conducted studies at a total cost of about $9 million (principally funded by transfer of funds from other Federal agencies and by the Federal-State Cooperative Program) which were initiated in response to information needs arising from Sections 208--Areawide Waste Treatment Management, and 404--Permits for Dredged or Fill Material, of the Act. For FY 1982, the estimated cost of such studies being conducted by USGS is about $9.5 million.

Surface-Water Quality Program

For the purpose of relating the surface-water quality activities of USGS to the Clean Water Act, I will describe and present results from: (1) our nationwide water-quality monitoring networks, and (2) our River Quality Assessment Program.

Nationwide Monitoring Networks

As previously noted, the USGS operates two nationwide networks to monitor surface-water quality--the National Hydrologic Benchmark Network and the National Stream Quality Accounting Network (NASQAN). The locations of stations in both networks are shown in Figure 3.

The Benchmark Network is composed of 52 small drainage basins which are as close as possible to their natural state, with little human influence and little likelihood of future development. Study of these basins, which encompass a wide variety of natural environments, may help to explain how much of the variation in water quality and quantity occurring in streams across the Nation is natural and how much is caused by human activity.

The NASQAN program, with 504 operating stations, provides a nationally uniform basis for continuously assessing the quality of U.S. rivers. Stations are located to represent outflow from accounting units (subregional drainage basins) which collectively encompass the entire land surface of the Nation.

Data collected in both networks include streamflow, field determinations, concentrations of major inorganic and trace consitituents (including toxic metals), the occurrence of bacterial indicators of pollution, and concentrations of a limited number of pesticide and radiochemical constituents.

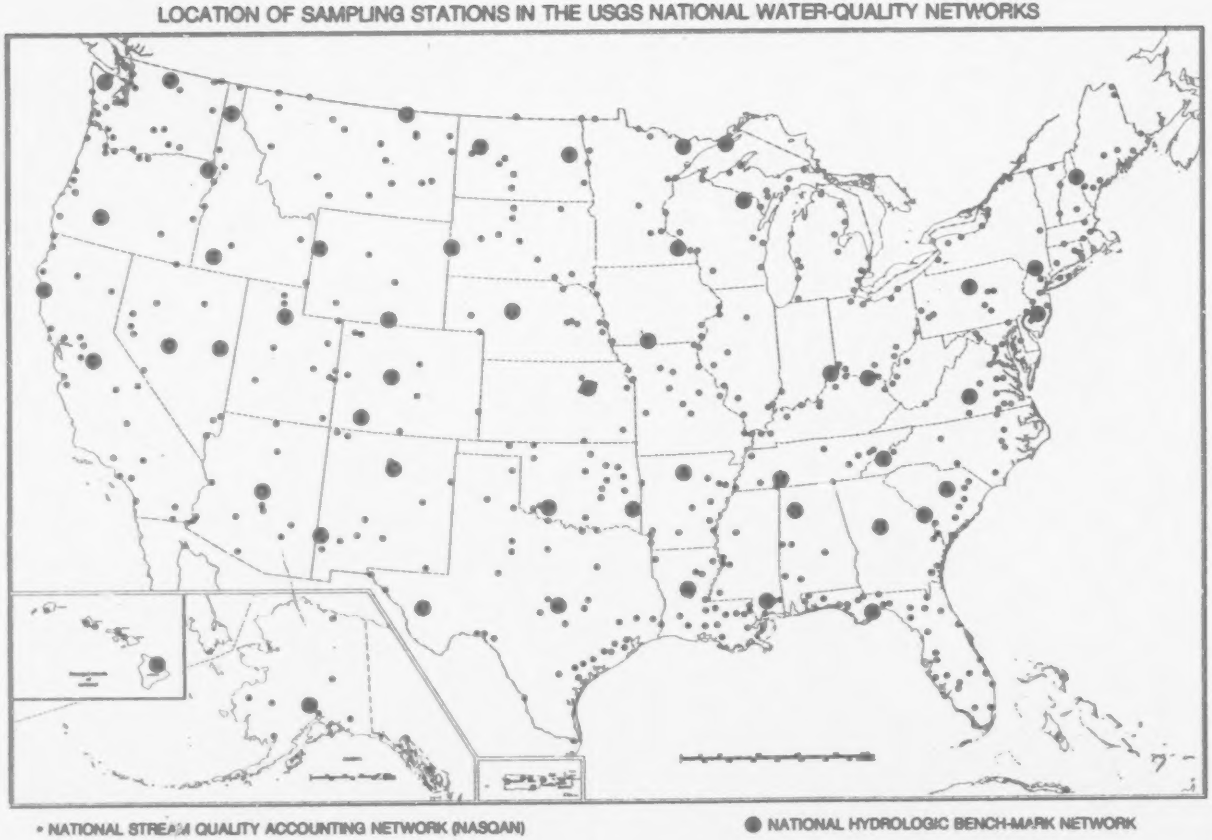

LOCATION OF SAMPLING STATIONS IN THE USGS NATIONAL WATER-QUALITY NETWORKS
• NATIONAL STREAM QUALITY ACCOUNTING NETWORK (NASQAN)
● NATIONAL HYDROLOGIC BENCH-MARK NETWORK

Figure 3.--Locations of stations in the Benchmark Network and the National Stream Quality Accounting Network.

The NASQAN network was begun in FY 1973 with 50 stations and implemented gradually to full level in FY 1979 with 518 stations. Funding for the NASQAN Program this fiscal year totals $4.3 million.

The Benchmark program is designed to answer the question, "What is the natural water quality in basins that have not been affected by man?" The NASQAN program, on the other hand, is designed to answer the questions, "What is the quality of water in the major river systems of the United States?" and "Is the quality changing?" It is important to note that neither of these programs has as its main purpose the determination of why water quality might be changing.

USGS has published and otherwise made available data and information from the National Water Quality Networks to a wide variety of users. All data collected in both programs are available in machine-readable format on magnetic tape from the Survey's Water Data Storage and Retrieval System (WATSTORE). Additionally, all water-quality data in our WATSTORE System are routinely entered into the STORET System of EPA. Beyond this, all of the USGS data are published annually by the Geological Survey in a report series on water resources data for each State.

Since water-quality data collection in the Benchmark Network began in 1963, three reports on Benchmark Network data have been published. A complete description of the basins (Cobb and Biesecker, 1971) includes location, drainage area, physiographic area, climate, topography, rock type, vegetation, man-made influences, gage location, flow characteristics, water quality, ground-water information, and availability of data. "Water Quality of Hydrologic Benchmarks--an Indication of Water Quality in the Natural Environment" (Biesecker and Leifeste, 1975) describes the dissolved solids, nitrate, heavy metals, and pesticide contents of the streams in the network.

It also compares the quality of streams in the "natural" environment with the water quality of major streams draining the same hydrologic regions. For example, Figure 4, an illustration from the report, shows that all streams draining Benchmark stations in this area contain less than 40 milligrams per liter (mg/L) of dissolved solids, whereas selected major streams in the same region contain from 40 to 300 mg/L of dissolved solids. Although several factors undoubtedly combine to produce this difference in dissolved solids concentrations, the urbanization of the northeast is probably the major factor.

A third report "Radiochemical Analyses of Surface Water from U.S. Geological Survey Hydrologic Benchmark Stations" (Janzer and Saindon, 1972) describes and lists the radiochemical data which had been collected prior to 1972. Concentrations of dissolved radiochemical constituents are generally low in streams draining Benchmark basins compared to concentrations in major rivers.

A number of topical reports based on data collected at NASQAN stations and focusing on a particular aspect of water quality have been published over the course of the program. Curtis and others (1973) made a comprehensive accounting of sediment discharge to the oceans from the conterminous United States, and Leifeste (1974) published a similar accounting of dissolved materials delivered to the oceans. In addition, Feltz (1980) did a study of pesticide concentrations at selected stations in the NASQAN network.

Recently, Smith and others (1982) reported a nationwide study of phosphorus trends at NASQAN stations. The report represents the first product of a recently established research project devoted to studies of the data collected in the national water-quality networks. The recent initiation of the research project reflects the fact that water quality record lengths in the NASQAN network (now typically in excess of 6 years of data) have finally become long enough for meaningful long-term trend analysis. To conduct the trend

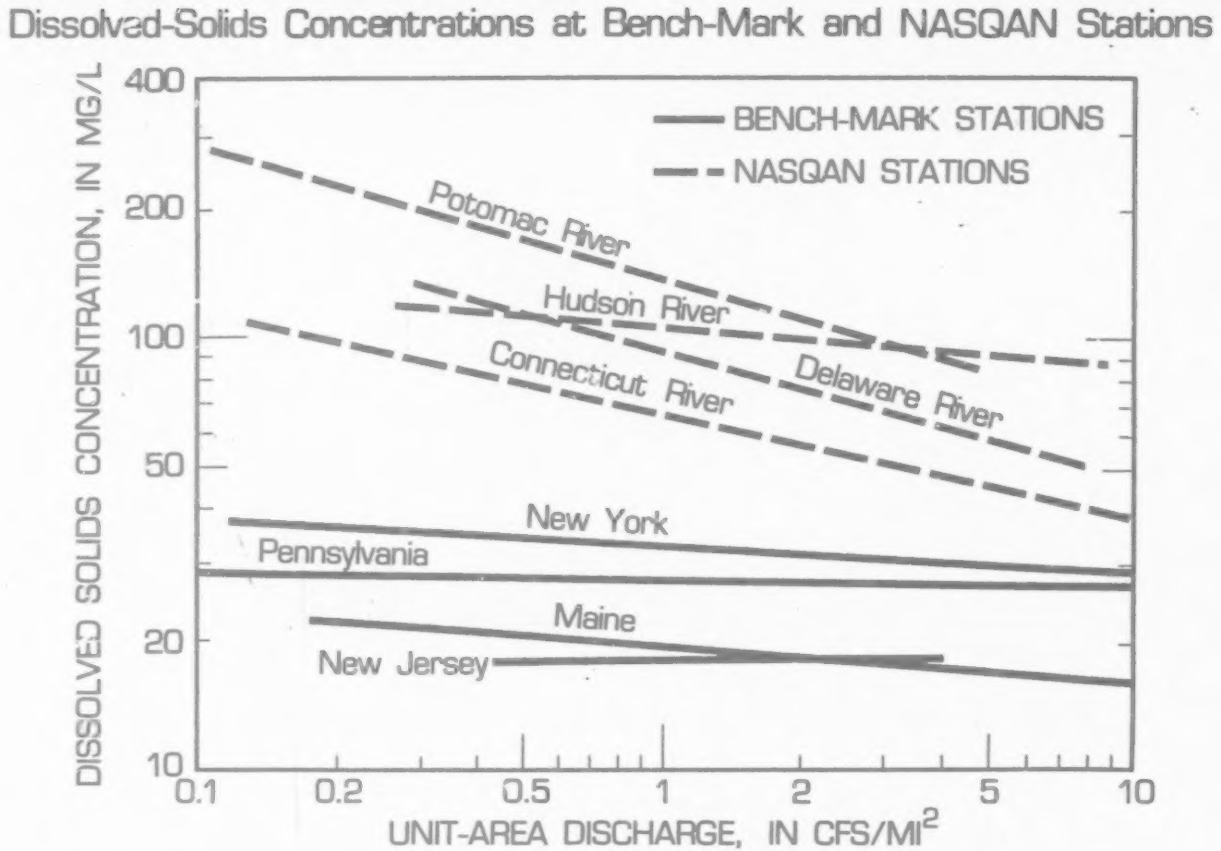


Figure 4.--Comparison of dissolved-solids concentrations at Benchmark and NASQAN stations.

analyses, special statistical techniques have been developed for detecting time trends in the water-quality data. Especially difficult has been the problem of separating human induced changes in water quality from the natural variability in quality that accompanies the changing seasons and the occurrence of wet and dry years. The recently developed trend techniques are described in a journal article by Hirsch and others (1982).

Figure 5 is taken from the recently completed study of national trends in river phosphorus concentrations. There have been widespread reductions in phosphorus levels over the latter 1970's except for part of the Midwest where observed concentrations have tended to increase. The fact that many of the rivers showing increases in phosphorus concentration drain areas that are largely agricultural suggests that nonpoint sources contribute a major part of the phosphorus in certain regions. The important function of the monitoring program has been to record the occurrence of changing phosphorus levels in a nationally consistent way so that some appreciation for regional changes can be gained. However, the explanation for why phosphorus might be rising or falling at individual stations can only be gained from studies of appropriate stream reaches.

The phosphorus report was recently published, and the District Offices of the Water Resources Division will soon be discussing the results with concerned State and local agency officials to ascertain the need for interpretive studies to determine the why cause(s) of observed changes. In addition, the Division's Research Program will review the results to determine if there is need for additional research on the processes which control the occurrence, movement, and fate of phosporus in surface waters. At the same time, the results will be conveyed to EPA and to other concerned Federal agencies for their information and use.

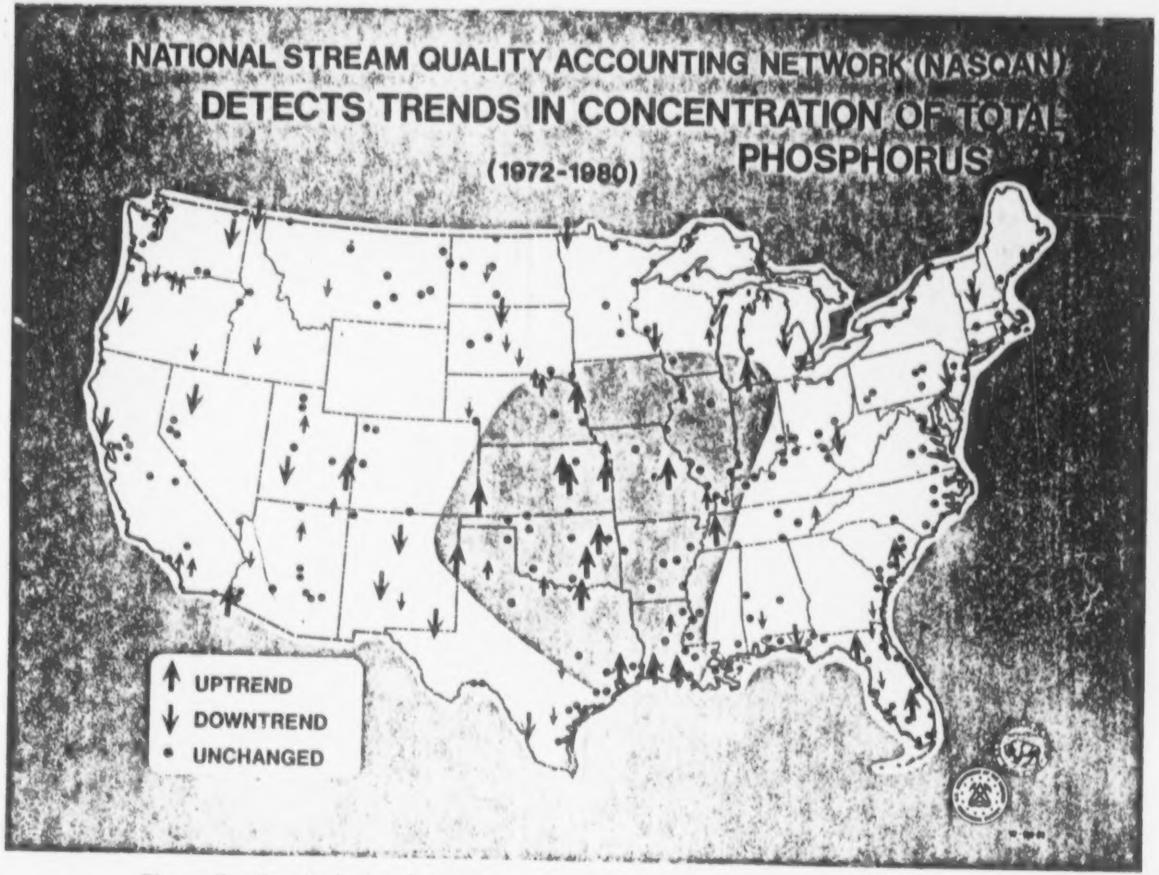
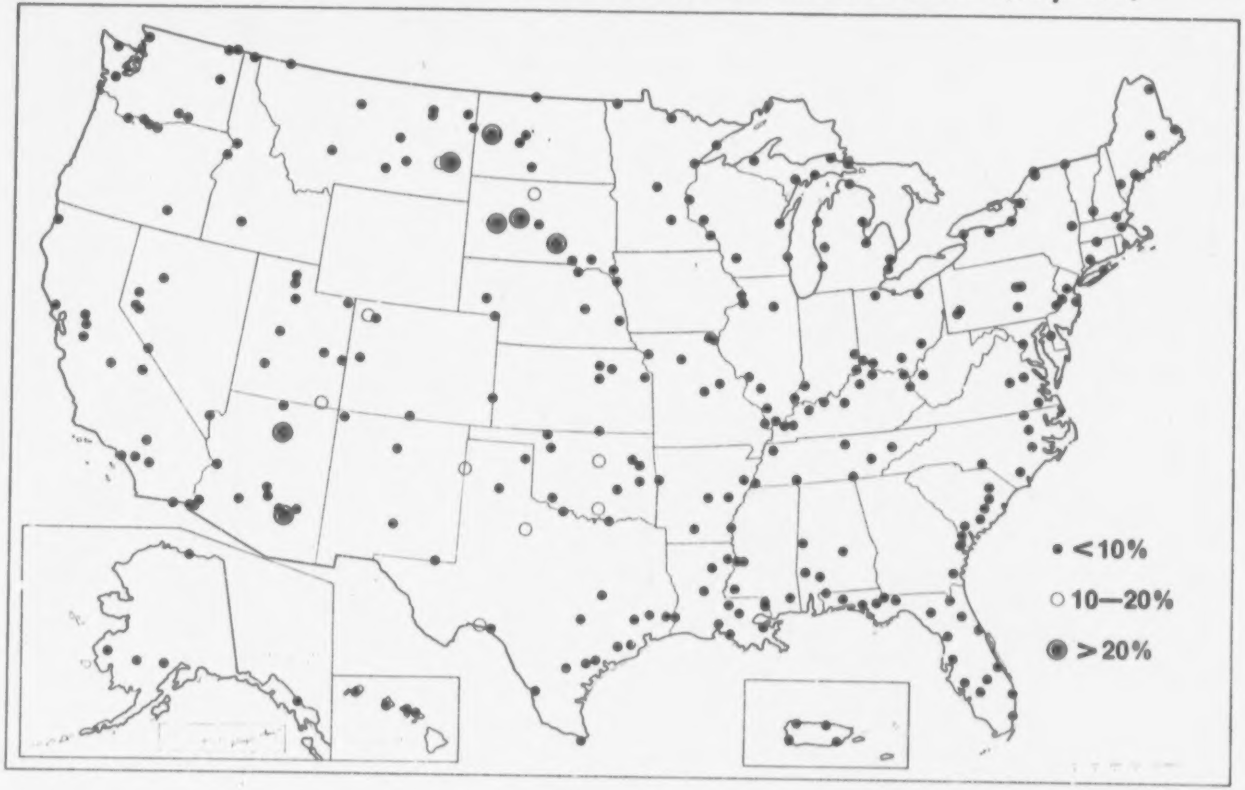

NATIONAL STREAM QUALITY ACCOUNTING NETWORK (NASQAN)
DETECTS TRENDS IN CONCENTRATION OF TOTAL PHOSPHORUS
(1972-1980)
UPTREND
DOWNTREND
UNCHANGED

Figure 5.--Trends in total phosphorus concentrations at NASQAN sites, 1972-1979.

The statistical procedures applied to the analyses of phosphorus data have recently also been applied to the entire NASOAN and Benchmark data base. A comprehensive statistical summary is now in preparation. In addition to analyzing for trends, analyses have been made to determine the frequency of violation of EPA water-quality standards for domestic water supply and freshwater aquatic life. These data speak directly to the question of the current status of the Nation's river quality; some examples of the results of the studies are presented here. For example, Figure 6 shows the location of stations at which chromium concentrations have exceeded the drinking water standard in more than 10 percent of the samples collected. As with many of the toxic "trace" metals, the occurrence of significant chromium concentrations in river water tends to be greater in the western States than in the East. Undoubtedly, this geographic pattern reflects both the natural, geologic occurrence of chromium as well as the location of human activities which introduce chromium into rivers. It is important to re-emphasize, however, that the objective of the NASOAN program *per se* does not include determination of why chromium is higher or lower at certain stations than at others, but simply the apparent fact that it is. Again, the next step is to communicate these results to concerned Federal, State, and local agencies in order to evaluate the need for specific investigations into *why* concentrations of chromium (and other substances) are relatively high in certain locations and to undertake the required investigations.

Figure 7 provides a summary of data on the frequency of exceeding standards for other selected toxic substances included in the monitoring program. In many of the basins sampled, water supplies are drawn from ground water rather than rivers or streams; thus, the comparison here to drinking



FREQUENCY OF EXCEEDENCE OF CHROMIUM STANDARD (50 μG/L)

Figure 6.--Frequency of exceedence of the drinking water standard for chromium at NASQAN stations.

Figure 7.--NUMBER OF STATIONS AT WHICH THE CONCENTRATION OF CERTAIN TOXIC SUBSTANCES EXCEEDED DRINKING WATER STANDARDS IN AT LEAST 10 PERCENT OF SAMPLES[1]

Metals	Standard (μg/1)	NASQAN	Bench-Mark
Arsenic	50	7 of 306 stations	0 of 21 stations
Barium	1000	5 of 85 "	0 of 14 "
Cadmium	20[2]	10 of 306 "	0 of 20 "
Chromium	50	16 of 306 "	0 of 23 "
Lead	200[2]	6 of 305 "	0 of 17 "
Mercury	2	4 of 306 "	1 of 25 "
Selenium	10	6 of 306 "	0 of 14 "
Silver	50	1 of 117 "	0 of 15 "

Pesticides	Standard (μg/1)	NASQAN
Endrin	0.2	0 of 143 stations
Lindane	4	0 of 142 "
Methoxychlor	100	0 of 133 "
Toxaphene	5	1 of 142 "
2, 4-D	10	0 of 30 "
Silvex	10	0 of 30 "

[1] Based on data collected from 1974 to 1981.

[2] Detection limit (higher than the standard).

water standards is only to provide a guide to environmentally relevant levels of the various substances.

The Hydrologic Benchmark and NASQAN Networks were designed to be multipurpose in character and to be useful for evaluating a wide range of water-quality problems. It is important in this context to note that the Hydrologic Benchmark Network can be useful for evaluating problems that were unrecognized when the system was initiated. For example, acid rain was not recognized as a water-quality problem in the United States when the Benchmark Network was initiated in 1963. However, because of the broad, multipurpose design of the network, it produces data which are presently proving to be of great value in analyzing the effects of acid rain on streams otherwise unaffected by man's activities.

River Quality Assessments

In 1971, the Geological Survey's Advisory Committee on Water Data for Public Use recommended that the USGS develop and apply an approach for conducting intensive, cause-effect interpretive studies of river-quality problems. The USGS responded by developing an approach which recognized that: (1) each river is physically and biologically unique, with unique water-quality problems and solutions, (2) intensive, applied studies can be conducted to provide a scientific basis for evaluating the effects of alternative water-resource management plans on river quality, and (3) if scientific results are to be used in decisionmaking, they must be effectively communicated to resource managers and to the public.

The first of a series of pilot, federally funded river-quality assessments (RQA's) was started in 1973 in the Willamette River Basin, Oregon. As shown in Figure 8, subsequent RQA's have been conducted on the Yampa River Basin in Colorado-Wyoming, the Chattahoochie River Basin in Georgia, the

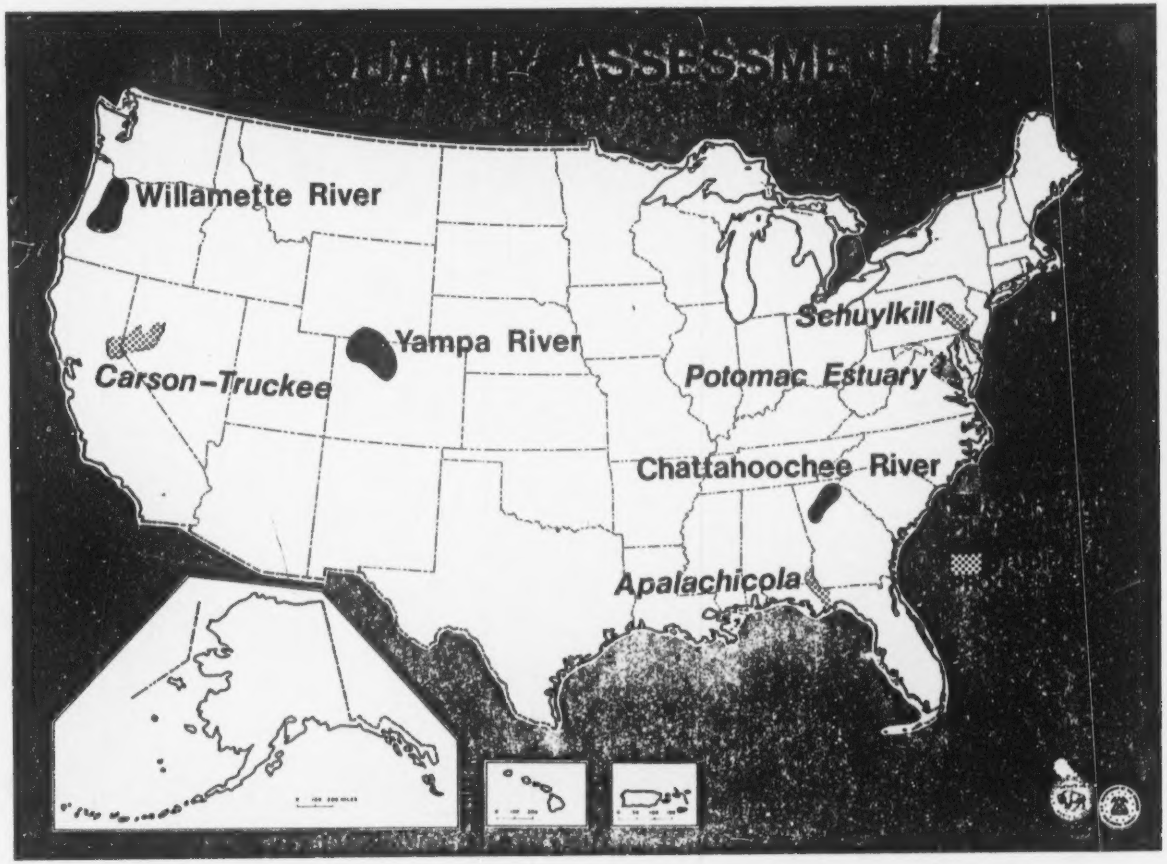

QUALITY ASSESSME
Willamette River
Carson-Truckee
Yampa River
Schuylkill
Potomac Estuary
Chattahoochee River
Apalachicola

Figure 8.--Location of U.S. Geological Survey pilot, river-quality assessment studies.

Schuylkill River Basin in Pennsylvania, the Apalachicola River in Florida, the Potomac Estuary in Maryland and the District of Columbia, and the Carson-Truckee River Basin in Nevada-California. Each of these demonstration projects was selected to address a markedly different hydrologic setting and a different set of problems in order to develop and test methods suitable for many unique situations.

The union of intensive interpretive studies to understand river-quality problems with communication of results to resource managers and the public has yielded gratifying returns.

In the case of the Willamette River, the maintenance of high-dissolved oxygen concentrations during summer low-flow periods was the the critical problem. At the time of the study, the dissolved oxygen concentrations in the river had been greatly improved through a highly successful waste-treatment program under which all point sources directly entering the Willamette received secondary treatment by 1972. However, dissolved oxygen levels in the river were still violating State standards in some locations during the low-flow summer season. The State was therefore faced with further costly upgrading of secondary treatment at municipal waste-water treatment plants, and, possibly, with the need for very expensive advanced waste treatment at some plants.

The Willamette RQA found (Rickert, Hines, and McKenzie, 1976; Rickert and Hines, 1978) that: (1) the major source of oxygen-demanding materials entering the river was ammonia from one industry, (2) further improvement of secondary treatment at municipal plants would have virtually no effect on dissolved oxygen levels, (3) flow augmentation would be needed to assure that dissolved oxygen standards would be met in the future, and (4) advanced waste treatment to decrease nitrogen and phosphorus concentrations in the river was not necessary to prevent algae blooms.

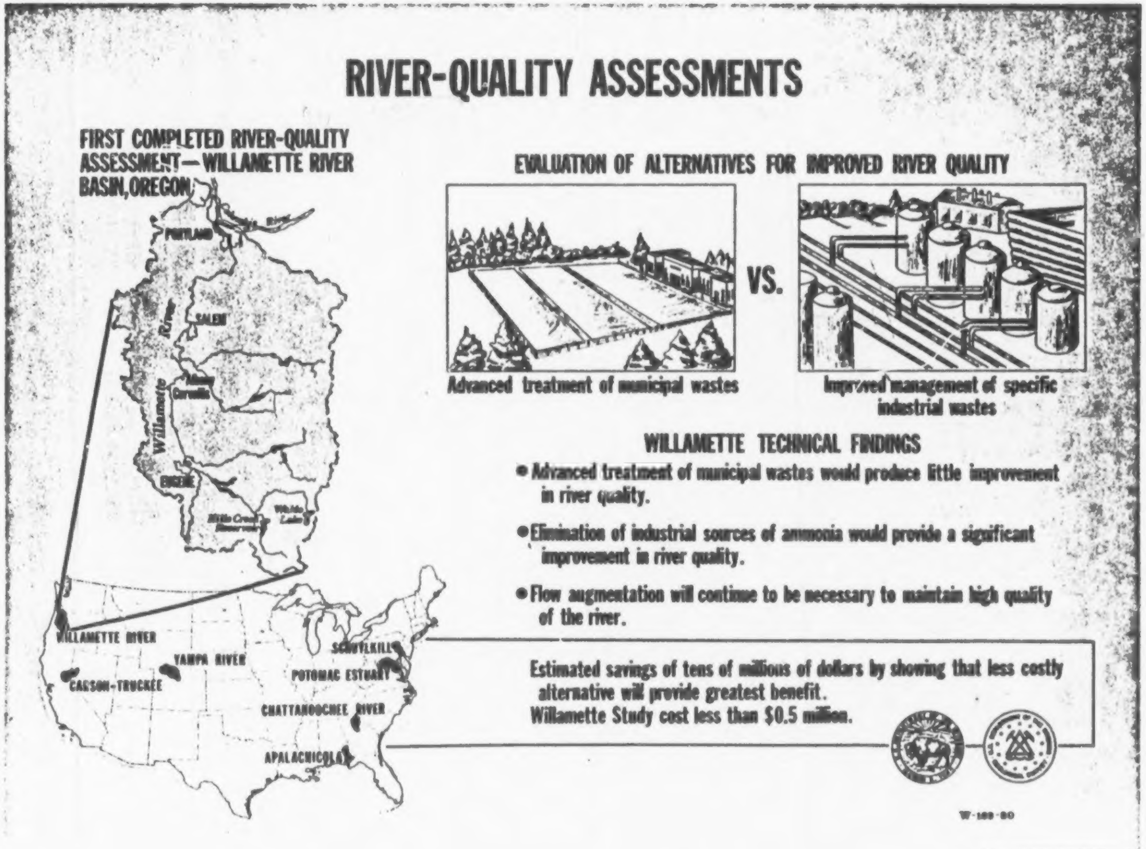
In December 1976, a Comptroller General's report to Congress entitled "Better Data Collection and Planning is Needed to Justify Advanced Waste Treatment Construction" stated that the Willamette ROA "may save several millions of dollars in Federal and State construction funding." In 1980, the Willamette ROA was reviewed (Rickert, 1981). It was found that the State of Oregon had implemented all the recommendations (Figure 9), and that predicted levels of improvement in dissolved oxygen had been attained.

Shortly before the close of the pilot ROA Program in FY 1981, USGS judged that the analytical approaches and methodologies for conducting ROA's were sufficiently well developed that future ROA's could be conducted in its Federal-State Cooperative Program. In FY 1982, 33 ROA-type studies are being conducted as part of the Cooperative Program.

Ground-Water Quality Program

Perspective

Unlike the NASQAN System, wherein surface waters can be relatively easily monitored to provide information about regional changes in water quality, a national network for ground-water monitoring would be a costly and ineffective method of evaluating the status of ground-water contamination. Ground-water velocities are usually very small, and pollution of ground water tends to occur in slowly developing pockets around point sources of contamination or in shallow, slowly-expanding zones beneath areas of nonpoint pollution. Because of the nature of the emplacement process, the actual volumes of contaminated ground water tend to remain small for long periods of time in comparison to the total volume of ground water circulating through the earth. Thus, a monitoring strategy in which samples are collected from observation wells chosen for areal coverage would fail to detect most developing contamination problems until a great deal of damage had been done. Moreover, a simple



RIVER-QUALITY ASSESSMENTS

FIRST COMPLETED RIVER-QUALITY ASSESSMENT—WILLAMETTE RIVER BASIN, OREGON

River
PORTLAND
SALEM
Willamette River
Albany
Corvallis
EUGENE
Hills Creek Reservoir
Waldo Lake
WILLAMETTE RIVER
YAMPA RIVER
CARSON-TRUCKEE
SCHUYLKILL
POTOMAC ESTUARY
CHATTAHOOCHEE RIVER
APALACHICOLA

EVALUATION OF ALTERNATIVES FOR IMPROVED RIVER QUALITY

Advanced treatment of municipal wastes

VS.

Improved management of specific industrial wastes

WILLAMETTE TECHNICAL FINDINGS

- Advanced treatment of municipal wastes would produce little improvement in river quality.
- Elimination of industrial sources of ammonia would provide a significant improvement in river quality.
- Flow augmentation will continue to be necessary to maintain high quality of the river.

Estimated savings of tens of millions of dollars by showing that less costly alternative will provide greatest benefit.
Willamette Study cost less than $0.5 million.

W-169-80

Figure 9.--Technical findings of the Willamette River Quality Assessment.

monitoring effort, without prior analysis and interpretation, is virtually guaranteed to fail, if for no other reason than the directions of flow away from a contaminant source must be understood before an efficient monitoring program can be designed.

The alternative strategy to monitoring used by the USGS has been to study areas where point and nonpoint sources of pollution are known to be affecting ground-water quality. This is the approach which the USGS has taken in virtually all of its work related to ground-water contamination. The approach is to study the hydrologic and geochemical processes affecting the movement of water and its constituents in different hydrogeologic settings in order to develop the scientific know-how for effectively and efficiently predicting contaminant fate and movement.

Ground-water contamination studies conducted by the USGS have focused on both toxic and nontoxic wastes. Examples of studies involving toxic wastes include the investigation of a 4,300 foot long leachate plume containing hexavalent chromium and cadmium which formed downgradient from an industrial area on Long Island (Ku and others, 1978); the movement of chemical-munition contaminated ground water near the Rocky Mountain Arsenal, Colorado (Konikow, 1977); the movement, alteration, and fate of industrial organic substances in ground water following injection through industrial wells near Wilmington, North Carolina (Leenheer and others, 1976); and near Pensacola, Florida (Ehrlich and others, 1979); the levels of various toxic metals in drainage from abandoned mines in Colorado (Wentz, 1974); isolation and characterization of TNT in ground water in Nevada (Pereira and others, 1979); and the study of leachate migration from a pesticide waste-disposal site in Hardeman County, Tennessee (Sprinkle, 1978).

In addition to process-oriented, site-specific studies such as those listed above, the USGS has undertaken studies specifically to assist the Environmental Protection Agency (EPA). In January 1977, an interagency agreement was signed stating that the USGS would assist EPA's Office of Drinking Water in gathering hydrologic data required to designate "sole source" (or principal source) aquifers under Section 1424 (e) of the Safe Drinking Water Act. The information required for each study includes: (1) a detailed description of the aquifer, and (2) background data on drinking water sources for the area presently using the potential aquifer. To date, the USGS has completed seven sole-source aquifer projects for EPA. Two new studies are now being initiated--the Delaware Basin Aquifers in Southeastern New Mexico and Western Texas, and the aquifers in Southeastern Louisiana and Southwestern Mississippi.

Another interagency agreement was signed on May 1, 1981, in which USGS agreed to provide technical assistance, information, and in some cases court testimony, on the geology and ground-water conditions at hazardous waste sites to EPA's Office of Solid Waste and Emergency Response. To date, EPA has requested the USGS to provide assistance on cases in Niagara Falls, New York; Jacksonville, Arkansas; Bridgeport, Pennsylvania; St. Louis Park, Minnesota; and New Brighton and Koppers Coke, Minnesota.

From all of our ground-water quality studies, the USGS estimates that less than 1 percent of the total volume of usable ground water stored in the Nation's aquifers has been contaminated. Although the volume is small, it tends to be concentrated in areas where use of ground water for human consumption is heaviest and, thus, the potential for hazards is greatest.

Programs to Evaluate Ground-Water Quality

Two current USGS programs--The Regional Aquifer Systems Analyses (RASA) and the Hazardous Waste Hydrology Programs--are designed to provide new information and knowledge concerning ground-water quality.

The RASA program was initiated in 1978 to determine the availability and chemical quality of ground water stored in regional aquifers, the recharge-discharge characteristics of the aquifers, and the hydrologic and geochemical controls that govern response of the aquifers to stress. A total of 28 aquifer systems have been identified for study (Figure 10) and the program is presently developing information on the quantity and quality of ground water in 15 systems, one being the Ogallala Aquifer which underlies the High Plains from South Dakota to Texas.

Although each RASA investigation is designed to fit the particular problems of the study area, the general approach is to develop a computer simulation of the overall aquifer system, supported by more detailed simulations of local or subregional problem areas. These simulations assist in forming an understanding of the natural (prepumped) flow regime and of the changes brought about by human activities. The simulation also provides a means of predicting effects of future pumpage, artificial recharge, waste disposal or other stresses, and will thus provide much of the basic information important to water-resource management.

In recognition that the present knowledge regarding toxic substances in ground water is inadequate, the USGS recently initiated a program in Hazardous Wastes-Ground Water Contamination. The President's budget calls for a funding level of $4.5 million in FY 1983 for this program. To direct this program, we established an Office of Hazardous Waste Hydrology in the Water Resources Division.

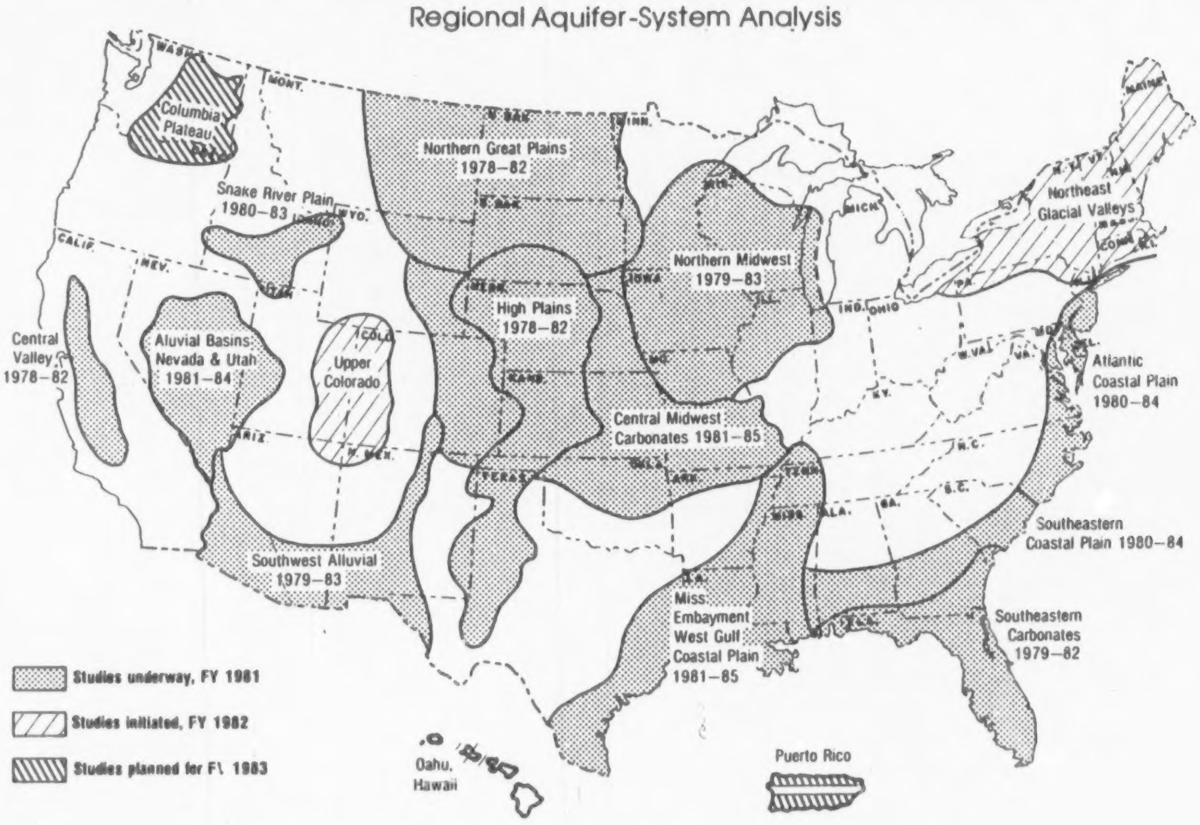

Regional Aquifer-System Analysis
Columbia Plateau
Snake River Plain 1980–83
Northern Great Plains 1978–82
Northern Midwest 1979–83
Northeast Glacial Valleys
Central Valley 1978–82
Aluvial Basins Nevada & Utah 1981–84
Upper Colorado
High Plains 1978–82
Central Midwest Carbonates 1981–85
Atlantic Coastal Plain 1980–84
Southeastern Coastal Plain 1980–84
Southwest Alluvial 1979–83
Miss. Embayment West Gulf Coastal Plain 1981–85
Southeastern Carbonates 1979–82
Oahu, Hawaii
Puerto Rico
Studies underway, FY 1981
Studies initiated, FY 1982
Studies planned for FY 1983
WASH.
MONT.
CALIF.
NEV.
WYO.
ARIZ.
COLO.
N. MEX.
N. DAK.
S. DAK.
NEBR.
KANS.
OKLA.
TEXAS
MINN.
IOWA
WIS.
MICH.
ILL.
MO.
ARK.
LA.
MISS.
TENN.
ALA.
GA.
FLA.
S.C.
N.C.
KY.
W. VA.
VA.
IND.
OHIO
PA.
N.Y.
VT.
N.H.
MAINE
MASS.
CONN.
R.I.
N.J.
MD.
DEL.

Figure 10.--Location of U.S. Geological Survey Regional Aquifer Systems Analyses studies.

The following briefly describes the major elements of the Hazardous Waste Ground Water Contamination Program:

1. Appraisal of existing ground-water quality.--This element includes the production of initial appraisals of natural and existing ground-water quality in individual States. These appraisals will be conducted through the integration and synthesis of existing information and knowledge by those personnel in the 46 Water Resources Division District Offices who are most familiar with aquifers in their District. Information will be included on ground-water quality in specified aquifers, waste-disposal sites and activities (as identified by State and Federal agencies), water levels, ground-water withdrawals and use, [waste-disposal sites and activities (as identified by State and Federal agencies),] and the general rate and direction of ground-water flow. An assessment and description of the vulnerability of aquifers to contamination in the near- and long-term will be included. The Geological Survey intends to publish reports on these appraisals. We expect to complete the initial appraisals for all 50 States by 1986.

2. Improving the understanding of geologic and hydrologic processes that control the behavior and fate of contamination in ground water.--This information is needed so that waste-disposal techniques can be improved and problems arising from improper disposal of wastes can be mitigated. Both proper disposal of hazardous waste and mitigation of contamination problems are strongly dependent on the properties of the specific aquifer and on the types of contaminants. Practical solutions require that principles of hydraulics, geochemistry, and microbiology be integrated to successfully study the complex systems found in nature. This program element will investigate several representative field problems to: (a) improve monitoring, sampling, and "exploration" procedures; (b) develop innovative techniques to neutralize,

immobilize, or remove contaminated ground water; (c) assess the overall reliability and value of predictive models for ground-water pollution; and (d) evaluate operational and monitoring strategies for ground-water quality restoration projects.

3. Identification of areas potentially suitable for the storage of hazardous wastes.--This element will involve: (a) identification of several specific hydrologic environments within each State that are the most preferable for waste disposal within that State; and (b) definition of geologic and hydrologic guideline criteria for site selection, including relations between the criteria and waste type for each general area identified in item (a). At the outset, meetings will be held with representatives of State governments to explain the program and seek their participation. For approving States, an advisory committee will be established to include members from State government, industry, and other Federal agencies. The USGS will aim to identify, in each State, as many as half a dozen areas whose hydrogeologic environment provides multiple natural barriers, such as those identified in Figure 11, to the movement of toxic wastes. Results of the USGS reconnaissance work will be made available to county agencies in addition to the appropriate State agencies. Further study, including selection of individual sites for detailed study and the development of engineering and construction codes, will be the responsibility of State and local governments.

4. Information transfer.--This phase of the program will include (a) project directories to identify what has and is being done within the USGS in connection with hazardous-waste studies; (b) derivative report and map products designed for ease of understanding and use by public and private sector planners and decisionmakers; and (c) workshops, symposia, and conferences

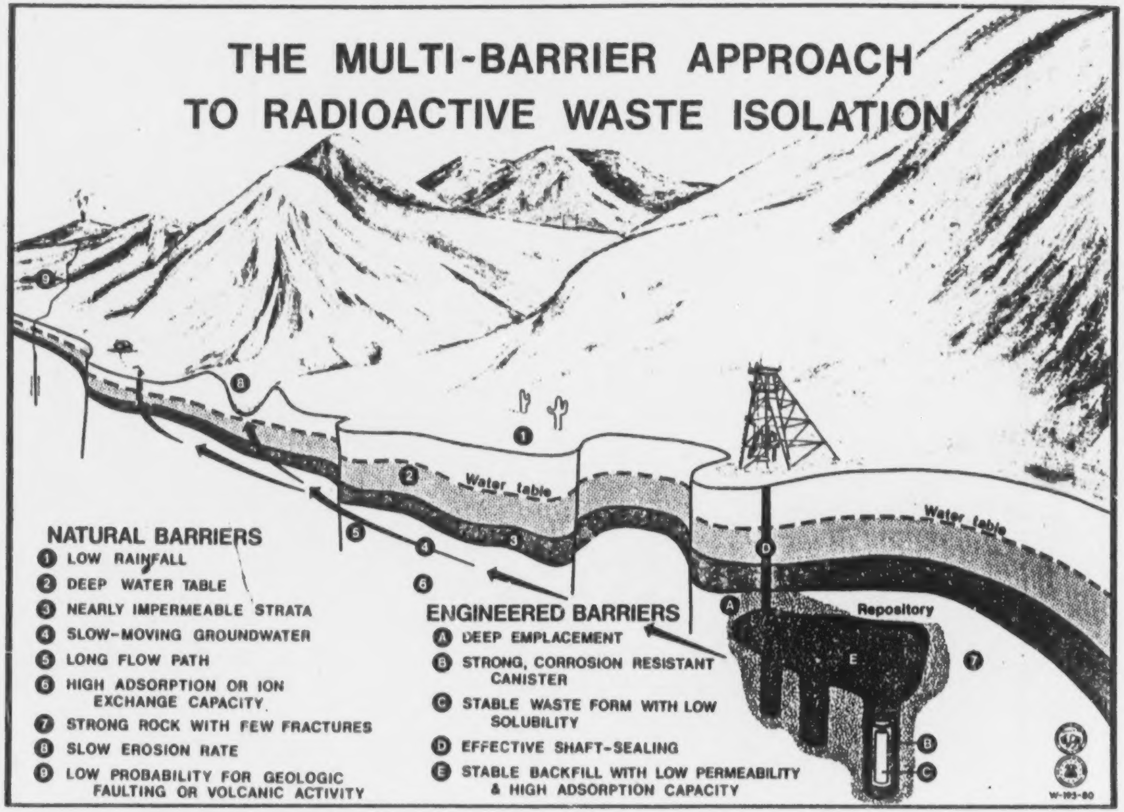

THE MULTI-BARRIER APPROACH TO RADIOACTIVE WASTE ISOLATION
Water table
Water table
Repository
E
A
B
C
D
1
2
3
4
5
6
7
8
9
NATURAL BARRIERS
① LOW RAINFALL
② DEEP WATER TABLE
③ NEARLY IMPERMEABLE STRATA
④ SLOW-MOVING GROUNDWATER
⑤ LONG FLOW PATH
⑥ HIGH ADSORPTION OR ION EXCHANGE CAPACITY
⑦ STRONG ROCK WITH FEW FRACTURES
⑧ SLOW EROSION RATE
⑨ LOW PROBABILITY FOR GEOLOGIC FAULTING OR VOLCANIC ACTIVITY
ENGINEERED BARRIERS
Ⓐ DEEP EMPLACEMENT
Ⓑ STRONG, CORROSION RESISTANT CANISTER
Ⓒ STABLE WASTE FORM WITH LOW SOLUBILITY
Ⓓ EFFECTIVE SHAFT-SEALING
Ⓔ STABLE BACKFILL WITH LOW PERMEABILITY & HIGH ADSORPTION CAPACITY
W-103-80

Figure 11.--The multi-barrier approach to radioactive waste isolation.

to bring together managers, planners, engineers, and scientists concerned with the development, siting, design, operation, and monitoring of land-disposal facilities for toxic wastes.

WHERE DO WE GO FROM HERE?

We are continually evaluating our programs in light of the changing needs for water information. We see already, from the initial trend analyses of the surface-water quality networks, that there is room for improvement and growth in our water-quality programs. The following changes are being evaluated in our surface water quality monitoring networks:

- o Constituents sampled
  - Increasing the number of analyzed Priority Pollutants.
  - Changing the list of pesticides/herbicides to reflect changing use.
    - * Increasing monitoring of herbicides because of a dramatic increase in their use.
    - * Reducing the number determined and/or frequency of analysis for older generation pesticides if a decline in their usage is established.
- o Detection limits
  - Conducting research to develop new analytical techniques with lower detection limits for important contaminants.
- o Sampling operations
  - Locating more sampling points on smaller rivers to achieve a more comprehensive picture of water quality under different land uses and types of hydrologic conditions.

  - Reducing the sampling frequency at sampling points which have been in the network for a long time, and at which concentrations of constituents, including toxics, are not showing trends or exceedence of standards for domestic water supply and freshwater aquatic life.

In the Hazardous Waste-Ground Water Contamination Program the big issues are: (1) what physical, chemical, and biological processes most affect the migration and fate of contaminants in ground water, (2) the development of geologic and hydrologic criteria for selecting geographic areas suitable for disposal of chemically and radioactive toxic substances, and (3) determining under what circumstances, if any, it is technically feasible and economically practicable to actually restore contaminated ground waters. Basic research is needed to resolve difficult technical problems regarding:

- The fate of low molecular weight, volatile organic substances in ground water.
  - Sample collection techniques must be developed and tested to insure that representative samples for analysis of volatile organic substances are collected.
  - Studies must define how volatile organic compounds move through the unsaturated and saturated zones--whether in solution or as a separate gaseous phase.
  - Remote-sensor techniques are needed to trace plumes of volatile organic compounds.
- Adsorption/desorption mechanisms of organic compounds and metals onto mineral or rock surfaces.
- The role of microbial processes in the alteration of toxic materials.

In summary, a sizable part of the USGS water-quality effort is dedicated to evaluating issues for which the Clean Water Act and related acts were enacted to address. We cooperate with a wide range of State, local, and other Federal water agencies in providing data and technical expertise to aid in addressing and solving toxic-waste problems. We intend to continue to make our research findings, expertise, and water data available to these agencies and organizations in order to be as responsive as possible to the Nation's needs for information and knowledge on the occurrence, fate, and safe disposal of toxic substances in the hydrologic environment.

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Mr. SCHEUER. Thank you very, very much, Mr. Langford.

Our distinguished colleague from Rhode Island, Mrs. Schneider.

Mrs. SCHNEIDER. Yes. I would like you to amplify one of your remarks. I'm afraid I didn't hear all of it. But when you were just now making your recommendations so far as ground water analysis is concerned, you mentioned the need to do more research in the area of disposing of toxic and/or nuclear wastes. Is that correct?

Mr. LANGFORD. That is correct.

Mrs. SCHNEIDER. Knowing what you know—and it seems to me that you are extremely well informed in this area—would you not be inclined to work under the assumption that there are perhaps more appropriate alternatives to disposing of our wastes in geologic sites underground, more appropriate ways of dealing with these wastes such as recycling or reusing them?

Mr. LANGFORD. Yes.

Mrs. SCHNEIDER. Because it seems to me that the USGS has a number of different problems on their agenda that you could be pursuing, and I would think this would be one that you would readily say, "Look, this would be a major problem that would require very special site specific geologic formations where we could feel absolutely 100 percent safe in disposing of such hazardous wastes." I would think that that would be your inclination and pass that buck on to another Federal agency, or on to business.

Mr. LANGFORD. That is correct. Our major concern is with the earth science aspects of the problem. Our attention is focusing on that part of the problem as opposed to the engineering aspects of the problem which you have described.

Mrs. **Schneider.** You also mentioned that we need to increase the number of priority pollutants. Just for my own benefit, how many priority pollutants are there at this time?

Mr. **Langford.** They are on the order of 120 to 130, I believe, as identified by EPA.

Mrs. **Schneider.** You have obviously some additional recommendations that would come into the category of about how many more; another 10, another 100, or what?

Mr. **Langford.** My remarks related to the identified priority pollutants and were in the context of the measurements that the Geological Survey is now doing within that suite of priority pollutants.

I would ask Dr. Pickering to comment on how many of those we are now measuring and what adjustment we feel is necessary within that suite.

Dr. **Pickering.** Of those 129, we have the capability in our laboratories, in close cooperation with EPA in terms of methodology, to measure all but about half-a-dozen of them. Some of those we don't measure because of the extreme toxicity of the substances, and it would require a special type of laboratory to take the precautions necessary to handle. But we can measure essentially the whole list.

We don't have specific views on what other things might be included in the list because that list has legal connotations as well as chemical and environmental connotations. There are, of course, many other substances, and when you get into toxic organics or organic contaminants in general, man has managed to make tens of thousands of such substances and it is necessary to pick and choose some of the most detrimental and some of the most common ones. We have essentially taken the cue from that list of EPA's.

Mrs. **Schneider.** But if there were no legal constraints upon you, would you be able to specifically identify additional chemicals that should be added to that list?

Are there some that continue to resurface in various water bodies that are not listed priority pollutants?

Dr. **Pickering.** Well, there are many, of the ones that have been problems for years, that are not on that list because of the nature of the chemicals that we would feel we would need to continue to measure. We measure over 700 specific water quality characteristics in the various phases of water, and at one place or another any one of those may be necessary to measure. So we feel that, besides that list that has been focused on in terms of pollution and toxic effects, we need to keep track of most of these other things in the places where they occur.

Mr. **Langford.** We are engaged in providing a multipurpose data base for water resources assessment that addresses not just the pollution problem but the utility of water for other purposes—irrigation, industrial water use, and so on. So the suite of substances and water quality characteristics is quite broad.

Mrs. **Schneider.** You also mentioned the need for improvement of research techniques in order to find various contaminants. Where do you think some of the best research is being done in order to do this? You mentioned you are working with EPA, but to what degree and what other agencies or universities or whatever are working along those lines?

Mr. **Langford.** We feel that some of the best research that is being done in these areas is being done in the Geological Survey, but not solely in the Geological Survey. The Environmental Protection Agency has many fine research efforts underway, and we work very closely with them in these areas.

For example, Mr. Robertson sits on the Advisory Committee for EPA's ground water research group. We have ongoing coordination arrangements with EPA to address a whole suite of areas—ground water research, water quality methodology for actual laboratory measurement of these various compounds, and joint storage and retrieval of the data from both the Geological Survey's and EPA's computerized water quality data files. Of course, the universities are engaged in research as well which contributes greatly.

The problem is so great that there is room for all kinds of very high level research.

Mrs. **Schneider.** But certainly not the budgetary research dollars that are necessary to support all of those different entities.

Mr. **Langford.** That may be.

Mrs. **Schneider.** That's what I am trying to focus on, when we have to do our various budget cuttings. We need to know who is doing the best job. It seems that one of our goals needs to be the elimination of duplication of effort. Although I recognize the value of duplication of effort in the research area, we don't want any overkill, either.

I have one final question which is a bit parochial. Are any of you gentlemen familiar with the ground water contamination that exists in Rhode Island? Have you been following that?

Mr. **Langford.** I am not personally familiar with the Rhode Island situation. John?

Mr. **Robertson.** Are you speaking about the Wood River nuclear plant?

Mrs. **Schneider.** Yes.

Mr. **Robertson.** The U.S. Geological Survey has a research project studying that problem. We don't have a report published on it yet.

Mrs. **Schneider.** I know. When?

We are most anxiously awaiting that report, and I will say that Rhode Island leads the Nation in terms of cancer deaths. There seems to be a great many problems that we are having with a variety of different toxic chemicals and nuclear waste in the State, and there are efforts to target populations and analyze them, and we are very much concerned about the health of the people who are living in this vicinity. I, for one, am most anxious to see some results, ASAP, so that we can take preventive measures or mitigating measures.

Mr. **Robertson.** We may have some preliminary information we could release to you in terms of data, or there may be a report close to approval that we can speed up and get it to you.

Mrs. **Schneider.** Terrific. Well, put in a word for me and I will be most anxious to have that report.

Thank you very much.

Mr. **Langford.** We would be pleased to do that.

Mrs. **Schneider**. Good. Thank you.

Thank you, Mr. Chairman.

Mr. **Scheuer**. Thank you very much.

Counsel, Miss Bach.

Ms. **Bach**. Mr. Langford, I would like to ask a question for the ranking minority member, Mr. Carney. He regrets that he cannot be here, but he has been designated as special adviser to the U.N. delegation on disarmament.

The question he would like to pose is: The committee is aware of the presence of USGS projects and activities on Long Island and the ground water problem situation on Long Island. What we would like you to do is either address here or for the record the USGS opinion on the quality of the ground water situation on Long Island, and also the present activities and ongoing projects that USGS is involved with and how it is distinguished from other agencies that are present and doing projects on Long Island, and also at the State, local, and Federal levels. So distinguish yourselves from those other projects that are occurring, and also to comment on the quality of the ground water. I would hope you would include not only the Nassau-Suffolk County aquifer system, but also the Brooklyn-Queens.

Mr. **Scheuer**. Yes, if you could do that orally for perhaps not more than a minute, and then submit your full statement in writing in answer to this excellent and somewhat comprehensive question.

Mr. **Langford**. I would be pleased to do that, Mr. Chairman.

The situation on Long Island is an extremely complex one with regard to ground water quality. The Geological Survey has a long history of very close cooperation with both Nassau and Suffolk Counties in the study of ground water resources and ground water contamination, and we will be pleased to provide that kind of detail for the record.

Mr. **Scheuer**. I can testify to the depths of Congressman Carney's concern. He has been constantly involved with this issue. Our subcommittee had a hearing in his district about a year ago on this issue, and he is extremely knowledgeable and vitally concerned. We would welcome an in-depth answer to that question.

Now, I am going to ask you one more question that you can answer in writing—and we will have other written questions for you, too. Your testimony stated that the national stream quality accounting network, NASQAN, is a monitoring network designed to answer the question "what is the quality of water in the major river systems of the United States, and is the quality changing." Since that monitoring network seems to have been in place long enough to give us some answers, some long-term trend analysis, what would your answers be to these questions as they relate to conventional and toxic pollutants?

Now, if you can just give us an overview in a minute or two and then give us a more detailed answer in writing, that would be helpful.

Mr. **Langford**. I would be pleased to do that, Mr. Chairman.

The data base from the NASQAN system is about 6 years old. It is only now long enough that we can begin to do some statistical analyses of those data. We can, of course, make observations as to the levels of observed concentrations of various substances, and we have done that. The table I have shown here indicates for certain characteristics, certain toxic characteristics, where they have been exceeded at least 10 percent of the time in the observed data.

As to the trends, as I indicated, the study is still underway. We have the phosphorus results, which I depicted, available, and we expect the study to be essentially completed for most of the constituents and the results to be out within the year. The results are showing some of the same kinds of things that the phosphorus data show. That is, in certain parts of the country there is a trend toward increasing concentrations in certain constituents; in other parts of the country no trend, or a downward trend.

For example, the chromium data show a trend that indicates increases in the western part of the country. Further studies to determine the cause of that trend are needed and will be undertaken by the Geological Survey—and I hope other agencies—as these data become available and as they become aware of the problem.

Mr. **Scheuer**. Thank you very, very much, Mr. Langford. You have been extremely helpful, extremely provacative, extremely thoughtful. We are grateful to you for your patience. You sat through a long morning of hearings. We will have some additional questions for you in writing.

With that, we will repeat our thanks and declare this meeting adjourned.

[Whereupon, at 11:56 a.m., the subcommittee was adjourned.]

THE RESEARCH NEEDS OF THE CLEAN WATER ACT

THURSDAY, JUNE 10, 1982

House of Representatives,
Committee on Science and Technology,
Subcommittee on Natural Resources,
Agriculture Research and Environment,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:46 a.m., in room 2318, Rayburn House Office Building, Hon. James H. Scheuer (chairman of the subcommittee) presiding.

Present: Representatives Scheuer, Carney, Sensenbrenner, Schneider, and Dunn.

Mr. Scheuer. The Subcommittee on Natural Resources, Agriculture Research, and Environment will come to order.

Today, we begin our second day of oversight hearings on the Clean Water Act and the research needed for its successful implementation.

Congress has to reauthorize the act this year, as you know, and in doing so, important and far-reaching policy decisions affecting water quality in this country must be confronted. The administration has proposed several changes to the Clean Water Act which are giving some of us concern. Some of these changes we fear may result in severe degradation of the Nation's water quality by weakening the act.

According to a recent Harris poll, 91 percent of the American public that was surveyed favored reenactment of the Clean Water Act with existing or more stringent regulation.

This poll also showed that 65 percent of the American public believe that pollution of the lakes and the rivers by toxic substances is currently a very serious problem.

This committee shares those concerns and will work to insure proper direction and support of the Clean Water Act.

On Tuesday of this week, this subcommittee received testimony from very prestigious scientists and environmentalists that revealed glaring deficiencies in our understanding of clean water contamination by toxic chemicals. These groups suggested that the administration's proposed amendments to the Clean Water Act would do serious harm to the quality of our Nation's waters.

Therefore, this subcommittee must determine the scientific validity and justification of the administration's proposed amendments.

Today, we are very happy to welcome the Deputy Administrator of the U.S. Environmental Protection Agency which is the Federal agency responsible for research and development in support of the Clean Water Act.

I would here note our particular concern over EPA's fiscal year 1983 budget request for water quality research. The Agency's request for $27.7 million represents a decrease of $17.3 million or a 40-percent decrease from the fiscal year 1982 request. If you factor in the eroding affects of inflation, this would be an approximately 5 percent cut or a 45- or 46-percent cut at the very least from the 1982 request.

In addition to the EPA witness, we will receive testimony from a very distinguished group of representatives from industrial, State, and municipal organizations.

Before we hear from our witnesses, I would like to turn to the representative of the minority on our subcommittee, the very distinguished contributing member of our subcommittee, Congressperson Claudine Schneider of Rhode Island.

[Mr. Scheuer's prepared statement follows:]

OPENING STATEMENT
HON. JAMES H. SCHEUER
JUNE 10, 1982

THE SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH, AND ENVIRONMENT WILL COME TO ORDER.

TODAY, WE BEGIN OUR SECOND DAY OF HEARINGS ON THE CLEAN WATER ACT AND THE RESEARCH NEEDED FOR ITS SUCCESSFUL IMPLEMENTATION.

THE CONGRESS MUST REAUTHORIZE THE ACT THIS YEAR AND IN SO DOING, IMPORTANT AND FAR-REACHING POLICY DECISIONS AFFECTING WATER QUALITY IN THIS COUNTRY MUST BE CONFRONTED.

THE ADMINISTRATION HAS PROPOSED SEVERAL CHANGES TO THE CLEAN WATER ACT WHICH FRANKLY, I FIND MOST TROUBLESOME.

THERE ARE MANY WHO SHARE MY CONCERN THAT THESE PROPOSALS WOULD WEAKEN THE ACT. ULTIMATELY THEY MAY RESULT IN SEVERE DEGRADATION OF THE NATION'S WATER QUALITY.

ACCORDING TO A RECENT HARRIS POLL, 91% OF THOSE SURVEYED FAVORED REENACTMENT OF THE CLEAN WATER ACT WITH EXISTING OR MORE STRINGENT REGULATION.

THIS POLL ALSO SHOWED THAT 65% OF THE AMERICAN PUBLIC BELIEVE THAT "POLLUTION OF LAKES AND RIVERS BY TOXIC SUBSTANCES" IS "CURRENTLY A VERY SERIOUS PROBLEM."

THIS SUBCOMMITTEE SHARES THESE CONCERNS AND WILL WORK TO ENSURE PROPER DIREC-

TION AND SUPPORT FOR THE CLEAN WATER ACT.

ON TUESDAY THE SUBCOMMITTEE RECEIVED TESTIMONY FROM A PRESTIGIOUS GROUP OF SCIENTISTS AND ENVIRONMENTALISTS THAT REVEALED GLARING DEFICIENCIES IN OUR UNDERSTANDING OF WATER CONTAMINATION BY TOXIC CHEMICALS.

THESE GROUPS SUGGESTED THAT THE ADMINISTRATION'S PROPOSED AMENDMENTS TO THE CLEAN WATER ACT WOULD DO SERIOUS HARM TO THE QUALITY OF OUR NATION'S WATERS.

THIS SUBCOMMITTEE MUST, THEREFORE, DETERMINE THE SCIENTIFIC VALIDITY OF THE ADMINISTRATION'S PROPOSED AMENDMENTS.

TODAY, WE WILL HEAR FROM THE DEPUTY ADMINISTRATOR OF THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, THE FEDERAL ENTITY RESPONSIBLE FOR RESEARCH AND DEVELOPMENT IN SUPPORT OF THE CLEAN WATER ACT.

I WOULD NOTE PARTICULAR CONCERN OVER EPA'S FY 83 BUDGET REQUEST FOR WATER QUALITY RESEARCH.

THE AGENCY'S REQUEST FOR $27.7 MILLION REPRESENTS A DECREASE OF $17.3 MILLION (40%) FROM THE FY 82 REQUEST.

IN ADDITION, WE WILL RECEIVE TESTIMONY FROM A DISTINGUISHED GROUP OF REPRESENTATIVES FROM INDUSTRIAL, STATE, AND MUNICIPAL ORGANIZATIONS.

STATEMENT OF HON. CLAUDINE SCHNEIDER, A MEMBER OF CONGRESS FROM THE STATE OF RHODE ISLAND

Ms. SCHNEIDER. Thank you very much, Mr. Chairman. I appreciate the opportunity to provide some opening remarks on the very important topic of the Clean Water Act research needs.

I think it is particularly important in a year when Congress will be reauthorizing three major pieces of legislation: the Clean Air Act, the Clean Water Act, and the Safe Drinking Water Act. It is critical that the Committee on Science and Technology take the initiative in coordinating hearings so that we can address the necessary research capabilities and the advances necessary in order to continue the protection of the streams, the lakes, and the rivers of this Nation.

Mr. Chairman, I would also like to compliment you and the staff for arranging these 2 days of hearings to assure that the input to the subcommittee is up to date and will better equip us for our reauthorizing responsibilities.

Tuesday of this week, we heard from six extremely distinguished and enlightening witnesses who unanimously have indicated that there are deficiencies in the science data base regarding toxic chemicals in both point and nonpoint sources, in groundwater systems, and also industrial and municipal sludge. I think that this is something that certainly is of serious concern to many of the members here. However, I believe the witnesses before us today from the industrial, State, and municipal organizations will indicate other deficiencies in the understanding of these same areas.

This is particularly disturbing, and it is the intent of this committee to see that such essential research needs are addressed.

I look forward to hearing the testimony of Dr. Hernandez, the Deputy Administrator of the EPA. I hope that he will bring some light to these apparent research needs.

That concludes my opening remarks, Mr. Chairman. Thank you for the opportunity.

[Mrs. Schneider's prepared statement follows:]

HONORABLE CLAUDINE SCHNEIDER
OPENING STATEMENT
RESEARCH NEEDS OF THE CLEAN WATER ACT
JUNE 10, 1982

THANK YOU, MR. CHAIRMAN, FOR THIS OPPORTUNITY TO PROVIDE MY OPENING REMARKS ON THE VERY IMPORTANT TOPIC OF THE CLEAN WATER ACT RESEARCH NEEDS.

IN A YEAR WHEN THE CONGRESS WILL BE REAUTHORIZING THREE MAJOR PIECES OF LEGISLATION FROM THE ENVIRONMENTAL PROTECTION AGENCY (CLEAN AIR ACT, SAFE DRINKING WATER ACT, AND CLEAN WATER ACT), IT IS CRUCIAL THAT THE COMMITTEE ON SCIENCE AND TECHNOLOGY TAKE THE INITIATIVE IN COORDINATING HEARINGS TO ADDRESS THE NECESSARY RESEARCH CAPABILITIES AND ADVANCES NECESSARY TO CONTINUE THE PROTECTION OF THE STREAMS, LAKES AND RIVERS OF THIS NATION. MR. CHAIRMAN, I COMPLIMENT YOU AND THE STAFF FOR ARRANGING THESE TWO DAYS OF HEARINGS TO ASSURE THE INPUT OF THIS SUBCOMMITTEE IN THIS UPCOMING REAUTHORIZATION.

ON TUESDAY, WE HEARD FROM SIX HIGHLY DISTINGUISHED AND ENLIGHTENING WITNESSES WHO UNANIMOUSLY HAVE INDICATED THAT THERE ARE DEFICIENCIES IN THE SCIENCE DATA BASE REGARDING TOXIC CHEMICALS IN BOTH POINT AND NON-POINT SOURCES, GROUND WATER SYSTEMS, AND INDUSTRY/MUNICIPAL SLUDGE.

WITNESSES BEFORE US TODAY, FROM THE INDUSTRIAL, STATE, AND MUNICIPAL ORGANIZATIONS WILL ALSO INDICATE DEFICIENCES IN THE UNDERSTANDING OF THESE SAME AREAS. THIS IS PARTICULARLY DISTURBING AND IT IS THE INTENT OF THIS COMMITTEE TO SEE THAT SUCH ESSENTIAL RESEARCH NEEDS ARE ADDRESSED.

I LOOK FORWARD TO HEARING THE TESTIMONY OF DR. JOHN HERNANDEZ THE DEPUTY ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY, AND HOPE THAT HE WILL BRING SOME LIGHT TO THESE APPARENT RESEARCH NEEDS.

THAT CONCLUDES MY OPENING REMARKS.

Mr. SCHEUER. Thank you, Congressperson Schneider.

All right. Dr. Hernandez, I take it, is the first witness. Do you want to introduce your colleagues for the record? We are very happy to have them.

STATEMENT OF JOHN HERNANDEZ, DEPUTY ADMINISTRATOR, U.S. ENVIRONMENTAL PROTECTION AGENCY, ACCOMPANIED BY TERRY YOSIE, DIRECTOR, SCIENCE ADVISORY BOARD; COURTNEY RIORDAN, ACTING ASSISTANT ADMINISTRATOR FOR RESEARCH AND DEVELOPMENT; STEVEN SCHATZOW, DIRECTOR, OFFICE OF REGULATIONS AND STANDARDS, OFFICE OF WATER; ERIC EIDSNESS, ASSISTANT ADMINISTRATOR FOR WATER; MARIAN MLAY, DEPUTY DIRECTOR, OFFICE OF DRINKING WATER; PETER PEREZ, SPECIAL ASSISTANT TO THE ASSISTANT ADMINISTRATOR FOR WATER

Dr. HERNANDEZ. Yes, sir. I certainly will.

Mr. SCHEUER. Why don't you do that. Before you start, let me say that your testimony will be printed in full following your oral remarks. We would ask you to chat with us informally for 7 or 8 minutes, and then I am sure we will have some questions for you.

Dr. HERNANDEZ. All right, sir.

Mr. SCHEUER. Also, I am going to ask unanimous consent that all members of the subcommittee be permitted to submit additional questions in writing, and we will hold the record open for 1 week or 10 days—whatever reasonable time it takes the subcommittee members to submit the question and our friends from EPA to answer the questions in writing.

There being no objection, so ordered.

All right, Dr. Hernandez, why don't you introduce your colleagues and then take your 7 or 8 minutes to chat with us.

Dr. **Hernandez**. Thank you, Mr. Chairman. This morning, I have with me Dr. Terry Yosie, the staff director for the EPA Science Advisory Board; Dr. Courtney Riordan——

Mr. **Scheuer**. Are we going left to right?

Dr. **Hernandez**. We are going right down the line with me here.

Mr. **Scheuer**. OK.

Dr. **Hernandez**. Dr. Courtney Riordan, the Acting Assistant Administrator for Research and Development; Mr. Steve Shatzow, Office of Water, Director of the Office of Water Regulations and Standards; Mr. Eric Eidsness, the Assistant Administrator for Water for the Agency; Marian Mlay, EPA's Office of Drinking Water; and Peter Perez, a special assistant who has had a great deal of activity in the drafting of our amendments to the Clean Water Act.

I will quickly read my testimony, Mr. Chairman.

Mr. **Scheuer**. Excuse me. Would you have somebody write those names down.

Dr. **Hernandez**. Yes, sir. I have them right here.

Mr. **Scheuer**. All right. Could you send that up?

Dr. **Hernandez**. Yes.

Mr. **Scheuer**. Maybe we will be addressing some questions to them.

Dr. **Hernandez**. I have them written down for you, sir.

Mr. **Scheuer**. Fine. They are available for questions directly?

Dr. **Hernandez**. Absolutely, sir.

Mr. **Scheuer**. Fine, thank you.

Dr. **Hernandez**. I would have to say that all of them represent career EPA staffers with the exception of Mr. Eidsness. Mr. Eidsness has been a previous employee of EPA prior to joining this administration.

Let me say that I compliment you on your panel that you have had the last two days. It was an excellent group of people. I think that the information provided will be of great value to you and to us. I have taken the opportunity to read some of the testimony already.

Mr. **Scheuer**. Excellent. Off the record.

[Discussion off the record.]

Dr. **Hernandez**. It is a pleasure to be here today to discuss the status of water quality in this country and EPA's related research and development activities.

In your letter, Mr. Chairman, you indicated that you wanted to focus on EPA's R&D initiatives in the context of our water quality program. Let me begin with a brief description of our water quality program and then move to our R&D.

EPA's water quality program derives primarily from the 1972 Clean Water Act. It should be recognized that both the act and the Agency's water quality program are premised on the concept that it is the primary responsibility of the States to prevent, reduce, and control water pollution to enhance the quality of the water in our lakes, streams, and coastal areas. The act calls for the Agency to develop nationally-applicable technology-based effluent limitations for the control of industrial and municipal point source discharges of materials that cause water pollution. EPA has developed the regulations and guidelines that provide for this technology-based approach: secondary treatment for publicly owned treatment works and best practicable treatment for industrial sources, so-called BPT.

The application of these rules has resulted in significant progress over the past 10 years in terms of facilities built and enhanced water quality. The overwhelming majority of industrial facilities now have BPT controls in place. The ability of publicly owned treatment works to remove conventional pollutants such as BOD and suspended solids has increased substantially since 1972. This progress represents a major commitment and investment on a national level of environmental control. Projections indicate that industry may ultimately spend as much as $18 billion in complying with BPT requirements, and the Federal investment to date in construction grants to local municipalities has been in excess of $33 billion.

The Agency and the States will continue to work together to achieve the objectives of the Clean Water Act through a national water quality program. Over the next several years, the process of issuing the remaining technology-based control regulations will largely have been completed. EPA has developed most of the technical and economic information needed to support the standards that remain unfinished. The Agency currently plans to complete the process of promulgating BAT guidelines for almost all major industries by 1984.

For municipal wastewater treatment plants, EPA is in the process of redefining secondary treatment as required under the 1981 Construction Grants Amendments to the Clean Water Act. This new definition will permit consideration of different types of treatment technologies for municipal sewage treatment plants as the equivalent to secondary treatment.

Technology-based controls will not be sufficient to achieve State-developed water quality standards in all stream segments. In these cases, known as water quality limited segments, the act provides for the establishment of additional and more restrictive effluent limitations based on water quality needs. As we have made good progress in implementing BPT and secondary treatment requirements, it is now time to look at those stream reaches that are not meeting State standards. Therefore, along with the completion of its effort to establish the uniform technology-based BCT and BAT guidelines, in the next several years, EPA will emphasize the more effective implementation of this water quality based approach as municipalities and industry reach the final stages of effecting the treatment required under the current technology-based standards. As a part of this effort in fiscal year 1983, the Agency will publish a revised water quality standards regulation. A site-specific criteria approach is under development that will allow the States to modify the EPA laboratory-derived criteria to reflect local environmental conditions. EPA will provide guidelines for use-attainability studies to States in their consideration of the environmental and economic factors affecting the attainment of the uses upon which water quality standards are based.

This approach will allow States to set attainable uses; develop site-specific criteria protective of those uses; identify water quality limited water bodies; prioritize them, taking into account the severity of pollution and the uses of the water; and develop and implement control plans. This also includes nonpoint sources, Mr. Chairman. Some of the information you received in the past few days relates to that.

To support these efforts, EPA is developing a monitoring strategy to encourage the use of selective biological and intensive surveys. Through this information, EPA and the States should be able to obtain the data necessary to measure the results of control strategies on the Nation's streams and water bodies. EPA will also encourage the use of the section 305(b) water quality inventory report as a basic document identifying each State's water quality status and needs.

Under the State and Federal partnership we believe that further substantial progress will be maintained in improving the Nation's water.

I am going to skip the next couple of pages, Mr. Chairman. They have to do with reports on some progress that has been made in specific rivers. I think that I will move down to page 7—the bottom of page 6 and on to page 7.

Historically, information on toxic pollutants has been much less complete than that for conventional pollutants. Nevertheless, over the past 5 years, EPA has performed an intensive review of available information and has sampled waterways and effluents to understand better the toxicity, production and use, environmental fate and effects, and potential for human exposure to pollutants in U.S. waters. EPA has focused on 65 classes of pollutants which were originally known or thought to be potential water quality problems.

First, many of the 65 classes of pollutants have been found not to be problems in surface waters. For instance, many of the synthetic organics disperse readily to the air, volatilize readily, and do not create water quality problems. On the basis of these and similar findings, we now believe that we should concentrate our efforts on a relatively small number of the 65 classes of pollutants which are known to be widespread and persistent in discharges and waterways and which may cause human health and aquatic problems. For example, included within those 65 classes of pollutants are 114 toxic organic compounds. In recent EPA sampling studies of 40 publicly owned treatment works [POTW's], only 15 of the organic compounds were found in more than 50 percent of the time in the influents to those facilities, that is, the incoming flow to the treatment facility.

Second, we are finding that the technology-based control programs now underway are removing significant amounts of toxic pollutants. Loadings of eight heavy metals to the Nation's waters from 26 industrial categories are projected to be reduced 80 to 90 percent from the 1972 levels after compliance with BPT controls. In terms of municipal facilities, the median removal rates in a sample of the 40 public treatment works, studied in detail, range from 63 percent to 70 to 80 percent for different types of organic chemicals.

However, while technology-based controls are addressing a large portion of the toxic pollutant problem, there are likely to be some areas and pollutants such as heavy metals and a few organics where further controls are necessary.

Mr. Chairman, I will move down into the ground water area which I think is important. This is on the middle of page 8.

In the protection of ground water, we believe that the States have the primary responsibility to address local problems of ground water pollution control. However, clearly, EPA has a role to play in supporting and assisting in this control effort. Toward this end, EPA has undertaken a comprehensive review of existing authorities related to ground water protection, the Agency's organizational capabilities, as well as any other tools that may be available to assist in this effort. On the basis of this review, we are in the process of developing a national ground water policy. Through our RCRA programs and underwater injection control program, EPA will provide the States with a set of national regulations to help prevent ground water pollution caused in the past by improper disposal of municipal and industrial wastes. The States will also be supported by the Agency's research, technical expertise, and capabilities.

Moving to the top of page 9, Mr. Chairman, we start on our R&D program.

To support and insure the successful operation of the water quality program I have just described, an integrated, well-planned water quality research and development program is vital. As you know, one of my principal objectives at EPA is to improve the scientific basis for our actions. The basic purpose of EPA's water R&D programs is to provide the scientific and technical foundation to evaluate, measure, and control pollutants that impact surface, subsurface, and coastal waters of the United States. Furthermore, understanding the impacts of various contaminant levels is essential in the protection of human health and aquatic life. Technical support to the program offices, regions, and States is an important role of these programs. The effectiveness of this program is demonstrated by the examples I have given earlier on the actual improvements in stream quality.

During the past decade, we have made significant progress in understanding the complex biological, chemical, and physical sciences and technology involved in managing and restoring aquatic resources. We have learned that with good management, aquatic resources, like other renewable natural systems, display a capacity to recover from stress.

Clearly, though, water quality problems remain which need better definition and improved ecological analysis.

Shall I go on, Mr. Chairman?

Mr. **Scheuer**. Yes, why don't you finish your testimony.

Dr. **Hernandez**. It will only take about 2 more minutes.

Mr. **Scheuer**. Yes.

Dr. **Hernandez**. Clearly, though, water quality problems remain which need better definition and improved ecological analysis. In the past, EPA's research and development focused on the national water quality criteria. Increasingly, however, we are finding that our criteria must be developed to focus on site-specific water conditions. We are learning that water chemistry, chemical mixtures, and local hydrological conditions significantly influence the toxicity of many pollutants. We are, therefore, turning to the development of tests which are based on field conditions and that integrate our knowledge of the transport and fate of toxic chemicals in the aquatic environment with available data on toxic effects of aquatic resources. We are placing our emphasis on this approach rather than on developing criteria based solely on the effects of individual chemicals on aquatic resources under laboratory conditions. The field or site-specific orientation will allow us to develop criteria protective of the existing fish population which in turn will translate into more pragmatic and rational water quality standards. We will, however, continue to pay close attention to priority pollutants as well as quickly responding to other individual toxic chemicals that may present a major threat to the environment. EPA's research and development program will provide the scientific and technical base to help the States develop stream standards to control pollutants that limit the desired use in these waters.

The water quality based approach requires monitoring for the biological breadth as well as the chemical content of water bodies. Our research will provide techniques for more effectively identifying existing and emerging problems and for assessing progress in the selection and attainment of reasonable water quality objectives. It also involves identifying the most cost-effective control strategies to achieve these objectives. It requires water quality management based on reliable scientific and technical information.

The key crosscutting R&D objectives involved in our plan for a water quality based approach involve the following:

Improved quality assurance and low-cost monitoring assistant to States;

Application and evaluation of bioassay techniques as mechanisms for assessing toxicity of complex effluents, especially for toxic organic chemical and metals;

Scientific consistency in evaluating hazards and risks in wastewater discharges;

Increased attention to cross-media implications of wastewater control options; and

Improved information transfer to users at State and local levels in industry.

We also expect to improve the scientific base necessary for implementation of the water quality approach in the following key research areas: Development of field-oriented information that characterizes the potential of a stream for biological production;

Improved modeling capabilities for waste load allocation processes that are important for managing discharges through permits. Research is needed to handle time-variant exposures and environmental dynamics in toxics, including fundamental information on the specific transformation and transport processes and the incorporation of these processes into operational systems models.

Mr. Chairman, at this point I will stop. Let me just summarize the last few pages. They describe our activities in research in the municipal area and one specific area in sludge management. Sludge management, we feel, is one of the most difficult ones that the Agency has not spoken to.

Some of our information that I provided to you on page 13 speaks on our groundwater research program where we have increased funds and which we feel is a dynamic one.

The last part of my testimony, Mr. Chairman, refers to the legislative changes that you have spoken to in your opening comments. I would like to assure you that I feel that there are no adverse and environmental consequences as a result of these legislative changes. Most of them have been recommended by a subcommittee of the House of Representatives in a December 1980 report to the Congress, a report that is signed by most of the members of the Public Works Committee.

Therefore, the bulk of our proposed legislative changes are found in that document.

I would be pleased to answer any questions that you now have.

[Dr. Hernandez's prepared testimony follows:]

STATEMENT OF
Dr. JOHN HERNANDEZ, JR.
DEPUTY ADMINISTRATOR
U. S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH, AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY

JUNE 10, 1982

Good morning, Mr. Chairman and members of the Subcommittee. I am John W. Hernandez, Deputy Administrator of the United States Environmental Protection Agency. I am accompanied today by Dr. Courtney Riordan, Acting Assistant Administrator for Research and Development. It is a pleasure to be here today to discuss the status of water quality in this country and EPA's related research and development activities.

In your letter of invitation, Mr. Chairman, you indicated that you wanted to focus on EPA's R&D initiatives in the context of our water quality program. Let me, therefore, begin with a brief description of our water quality program. I will then discuss current research and development and possible future directions.

Water Quality Program

EPA's water quality program derives primarily from the 1972 Clean Water Act. It should be recognized that both the Act and the Agency's water quality program are premised on the concept that it is the primary responsibility of the States to prevent, reduce, and control water pollution and to enhance the quality of the water in our lakes, streams and coastal areas. The Act calls for the Agency to develop nationally applicable technology-based effluent limitations for the control of industrial and municipal point source discharges of materials that cause water pollution. EPA has developed the regulations and guidelines that provide for this technology based approach: secondary treatment for publicly owned treatreatment works (POTW) and best practicable treatment (BPT) for many industrial sources.

The application of these rules has resulted in significant progress over the past ten years in terms of facilities built and enhanced water quality. The overwhelming majority of industrial facilities now have best practicable treatment (BPT) controls in place. The ability of publicly owned treatment works to remove conventional pollutants such as BOD and suspended solids has increased substantially since 1977. This progress represents a major commitment and investment on a national level in environmental control. Projections indicate that industry may ultimately spend as much as $18 billion in complying with BPT requirements and the Federal investment to date in construction grants to local governments is in excess of $33 billion.

The Agency and States will continue to work together to achieve the objectives of the Clean Water Act through the national water quality program. Over the next several years, the process of issuing the remaining technology-based control regulations will largely have been completed. EPA has developed most of the technical and economic information needed to support the standards that remain unfinished. The Agency currently plans to complete the process of promulgating BAT guidelines for almost all major industries by 1984.

For municipal wastewater treatment plants (POTWs), EPA is in the process of redefining secondary treatment as required under the 1981 Construction Grants amendments to the Clean Water Act. This new definition will permit consideration of different types of treatment technologies for municipal sewage plants as the equivalent to secondary treatment.

Technology-based controls will not be sufficient to achieve state developed water quality standards in all stream segments. In these cases, known as water quality limited segments, the Act provides for the establishment of additional and more restrictive effluent limitations based on water quality needs. As we have made good progress in implementing BPT and secondary treatment requirements, it is now time to look at those stream reaches that are not meeting State standards. Therefore, along with completion of its effort to establish the uniform technology-based BCT and BAT guidelines, in the next several years EPA will emphasize the more effective implementation of this water quality based approach as municipalities and industry reach the final stages of effectuating the treatment required by current technology based standards. As part of this effort, in FY 1983 the Agency will publish a revised water quality standards regulation. A site-specific criteria approach is under development that will allow the States to modify the EPA laboratory-derived criteria to reflect local environmental conditions. EPA will provide guidelines for use-attainability studies to States in their consideration of the environmental and economic factors affecting the attainment of the uses upon which their water quality standards are based.

This approach will allow States to set attainable uses; develop site-specific criteria protective of those uses; identify water quality limited water bodies; prioritize them, taking into account the severity of pollution and the uses of the water; and develop and implement control plans. Using the information generated in setting water quality standards, States will be able to prepare wasteload allocations (WLAs) and total maximum daily loads (TMDLs) as a basis for issuing permits under the National Pollution Discharge Elimination System (NPDES).

To support this effort, EPA is developing a monitoring strategy to encourage the use of selective biological and intensive surveys. Through this information, EPA and the States should be able to obtain the data necessary to measure the results of control strategies on the Nation's streams and water bodies. EPA will also encourage the use of the section 305(b) water quality inventory report as a basic document identifying each State's water quality status and needs.

Under this State-federal partnership we believe that substantial further progress will be made in maintaining and improving the quality of this Nation's water. While there is no question that much work remains to be done, this should not take away from the impressive efforts and accomplishments since 1972.

Implementation of BPT regulations for industry are estimated to have reduced industrial discharges of six key pollutants substantially from 1972 to 1977: biochemical oxygen demand (BOD) by 71 percent; suspended solids by 80 percent; oil and grease by 71 percent; dissolved solids by 52 percent; phosphate by 74 percent; and heavy metals by 78 percent. These figures reflect the fact that there is presently a 90 percent major industrial compliance rate.

The increased treatment levels in sewage treatment plants (POTWs) have offset the increase in pollutant loads that have occurred because of increasing population, new sewers, and population shifts. In other words, the total amount of pollutants entering the Nation's waters from POTWs has remained roughly constant in the last decade, even though the municipal sewage flow increased almost by 7 billion gallons per day. Presently, 76 percent of major municipal facilities are in compliance with their permits.

As a result of these overall reductions in pollutant loadings, river quality is improving. For example, at many sites in the Northeast, Southeast, and Great Lakes areas dissolved oxygen levels showed improvements from 1971-1972 to 1977-1978. There has also been a significant decline in the number of incidents of fish kills reported in the past decade in general and from both municipal and industrial operations. In addition, we are finding that levels of certain toxic chemicals found in fish are declining. One example of this is that DDT levels in Lake Michigan fish have dropped 90 percent since 1969. Reports indicate that levels of Aldrin and Dieldrin found in fish are going down and there are now indications that in certain areas levels of PCB's in fish are beginning to decline as well.

While it is difficult to find hard data, there are numerous local examples of improved water quality, particularly in areas where POTW effluents have been improved. These local success stories are the most heartening aspect of our cleanup programs, since many of our water quality problems are very localized in nature. Some examples are:

o The Potomac River shows the return of several desirable fish species and marked reductions in phosphorus (68 percent) and BOD (30 percent) as a result of construction grant projects.

- The Naugatuck River and Lower Housatonic River in Connecticut have shown enough improvement to enable upgrading of some sections to fishable/swimmable status.
- Beaver Creek in Knoxville, Tennessee, has been restored for swimming, fishing, and wading, and is now a safe and reliable source of water supply.
- Alabama reports an increase in the number of monitoring sites meeting standards from 39 percent in 1978 to 59 percent in 1979 as a result of improved POTWs.

I am pleased to note that this list of improvements could go on for several pages, and is growing every year.

So far I have focused on "conventional" pollutants such as BOD, suspended solids and bacteria which can cause sanitation and human health problems. In the past few years, we have become much more aware of the presence of less visible but potentially even worse problems from "toxic pollutants" including pesticides, heavy metals, industrial chemicals, and others that can cause human health and aquatic life problems when present even in small amounts.

Historically, information on toxic pollutants has been much less complete than that for conventional pollutants. Nevertheless, over the past five years, EPA has performed an intensive review of available information and has sampled waterways and effluents to understand better the toxicity, production and use, environmental fate and effects, and potential for human exposure to pollutants in U.S. waters. EPA has focused on 65 classes of pollutants which were originally known or thought to be potential water quality problems.

First, many of the 65 classes of pollutants have been found not to be problems in surface waters. For instance, many of the synthetic organic chemicals disperse readily to the air, volatize rapidly, and do not create water quality problems. On the basis of these and similar findings, we now believe that we should concentrate our efforts on a relatively small number of the 65 classes of pollutants which are known to be widespread and persistent in discharges and waterways, and which may be causing human health and aquatic life problems. For example, included within those 65 classes of pollutants are 114 toxic organic compounds. In recent EPA sampling studies of 40 POTWs, only 15 of the organic compounds were found more than 50% of the ime in the influents to those facilities.

Second, we are finding that the technology-based control programs now underway are removing significant amounts of toxic pollutants.

Loadings of eight heavy metals to the Nation's waters from 26 industrial categories are projected to be reduced 80-90 percent from 1972 levels after compliance with technology-based controls (BPT). In terms of municipal facilities, the median removal rates in a sample of 40 POTWs studied in detail range from 63 percent for total metals, to 70-80 percent for different types of organic chemicals.

However, while technology-based controls are addressing a large portion of the toxic pollutant problem, there are likely to be some areas and pollutants (some heavy metals, and a few organics) where further controls will be necessary.

In addition, it is important to recognize that the challenges in the area of toxic control are not limited to surface waters. Increased emphasis on monitoring groundwater supplies has led to the discovery of incidents of contamination which in certain localities has been quite severe. Groundwater is an essential but vulnerable natural resources and there is no question that its contamination must be avoided.

In the protection of groundwater, we believe that States have the primary responsibility to address local problems of groundwater pollution control. But clearly, EPA also has a role to play in supporting and assisting in this control effort. Towards this end, EPA has undertaken a comprehensive review of existing authorities related to groundwater protection, the Agency's organizational capabilities, as well as any other tools that may be available to assist in this effort. On the basis of this review, we are in the process of developing a national groundwater policy which provides States with the primary responsibility to deal with the issue on a case by case basis supported by the Agency's research and technical expertise and capabilities.

We believe that the States are able to monitor for and identify local toxic problems and develop solutions. Through its regional programs and laboratory system, EPA will provide technical support to the States. With many of the analytical tools developed by EPA, and with information already being generated in many cases by the States, it should be possible to set clear priorities.

Research and Development

To support and ensure the successful operation of the water quality program I have just described, an integrated, well planned water quality research and development program is vital. As you know, one of my principal objectives at EPA is to improve the scientific basis for our actions. The basic purpose of EPA's water R&D programs is to provide the scientific and technical foundation to evaluate, measure, and control pollutants that impact surface, subsurface, and coastal waters of the United States. Furthermore, understanding the impacts of various contaminant levels is essential in the protection of human health and aquatic life. Technical support to the Program Offices, Regions, and States is an important part of these programs. The effectiveness of this program is demonstrated by the examples I gave earlier of the actual improvements in stream quality.

During the past decade we have made significant progress in understanding the complex biological, chemical, and physical sciences and technology involved in managing and restoring aquatic resources. We have learned that with good management, aquatic resources, like other renewable natural systems, display a capacity to recover from stress.

Clearly, though, water quality problems remain which need better definition and improved ecological analysis. In the past, EPA's research and development focused on national water quality criteria. Increasingly, however, we are finding that our criteria must be developed to focus on site-specific water conditions. We are learning that water chemistry, chemical mixtures, and local hydrological conditions significantly influence the toxicity of many pollutants. We are therefore turning to developing tests based on field conditions and integrating our knowledge of the transport and fate of toxic chemicals in the aquatic environment with the data base of toxic effects on aquatic resources rather than developing criteria based solely on the effecttts of many individual chemicals on aquatic resources under laboratory conditions. The "field", or site specific, orientation will allow us to develop criteria protective of existing fish populations which in turn will translate into more pragmatic and rational water quality standards. We will, however, continue to pay close attention to priority pollutants as well as quickly responding to other individual toxic chemicals that present a major threat to the environment. EPA's research and development program will provide the scientific and technical base to help States develop stream standards to control pollutants that limit the desired use of these waters.

The water quality based approach requires monitoring for the biological breadth as well as the chemical content of waterbodies. Our research will provide techniques for more effectively identifying existing and emerging problems, and for assessing progress in selection and attainment of reasonable water quality objectives. It also involves identifying the most cost effective control strategy to achieve the objectives. It requires water quality management based on reliable scientific and technical information.

The key crosscutting R&D objectives involved in our plan for a water quality based approach involve the following:

- Improved quality assurance and low-cost monitoring assistance to States;
- Application and evaluation of bioassay techniques as mechanisms for assessing toxicity of complex effluents, especially for toxic organic chemicals and metals;
- Scientific consistency in evaluating hazards and risks in wastewater discharges;
- Increased attention to cross-media implications of wastewater control options;
- Improved information transfer to users at State and local levels and in industry.

We also expect to improve the scientific base necessary for implementation of the water quality approach in the following key research areas:

- Development of field oriented information that characterizes the potential of a stream for biological production.
- Improved modeling capabilities for the waste load allocation processes that are important for managing discharges through permits. Research is needed to handle time-variant exposures and environmental dynamics in toxics, including fundamental information on specific transformation and transport processes and the incorporation of these processes into operational systems models.

In the area of municipal wastewater treatment, the operation of existing and newly constructed systems utilizing conventional technology can be made more efficient, but ORD needs to determine if improved process design and operational procedures for treatment systems yield operational improvements with commensurate decreases in operating costs. The performance characteristics and cost effectiveness of innovative treatment processes placed in service through the construction grant Innovative/Alternative Technology program must also be evaluated utilizing the expertise of the research staff. Results of these evaluations will be made readily available to consulting engineers, state agencies, and others in the user community in order to ensure that the most cost effective technology is incorporated into the design and construction of new treatment works.

Improved sludge management is a another research area of great importance that potentially will affect every community in the country. Sludge production varies with the treatment process chosen to meet water quality requirements. Research must assess the environmental risks associated with application of sludge to the land, ocean disposal and incineration against the costs and environmental benefits involved. The net effect of these efforts will be to minimize the environmental impacts, energy use, and costs associated with sludge management. Research is needed to improve sludge stabilization processes and reduce the total amount of solids leaving the treatment plant. Analytical methods that characterize the chemical composition of sludge have not been fully validated.

As I noted above, the Agency has essentially completed its effluent guidelines research, but information is still needed on least-cost industrial pollution control options, on treatability, on how to establish permit discharge limitations for complex industrial effluents, and on ensuring compliance monitoring data accuracy. We see this primarily as a technology transfer activity. We are also looking strongly to the private sector to further develop and market improved industrial pollution control technolgy.

Our science for assessing and predicting the impacts of ground water pollution has lagged behind that of surface water. In the past few years important gains have been made by the EPA ground water research program in technology for accessing the subsurface and for taking samples that are uncontaminated by the sampling process. Further, we know reasonably well how a few organic chemicals of concern behave in ground water, as long as the hydrogeology of the aquifer is known (determining the hydrogeology of an aquifer is an area of research we leave to the U.S. Geological Survey). However, a great deal remains to be done to: (1) improve and reduce the cost of ground water contamination investigations (e.g., methods for detecting pollution without drilling), (2) improve our capability for predicting organic and microbiological contaminant behavior, and (3) determine the appropriate level of protection. Our Groundwater Research Program responding to these needs is closely coordinated with the U.S. Geological Survey (U.S.G.S.) under the EPA/U.S.G.S. memorandum of understanding.

The disposal of municipal and industrial wastes through ocean outfalls is expected to increase in the 1980's. The scope of this usage and the ultimate long-range impacts on the marine environment and our society are questions we are preparing to answer. Our research program needs to evaluate and predict the consequences of disposal of various wastes in the marine environment.

Finally, it is critical that ORD further develop and maintain the capabilities to undertake fundamental scientific and engineering investigations. Research projects are conducted at EPA's laboratories and Research Centers and under the Grants Program for supporting colleges and universities. Ongoing or proposed fundamental and applied work on basic environmental processes, such as toxicology, microbiology, chemistry, and engineering will continue. This fundamental capability provides the foundation for handling emerging problems and for any breakthroughs in understanding problems and developing alternative solutions. These basic research investigations provide the basis for low cost solutions to future water quality problems and for the sound technical foundation for our regulatory efforts.

Legislative Changes

A final area I would like to touch on is the Agency's legislative package of proposed amendments to the Clean Water Act recently submitted to Congress for its review and consideration. These proposed legislative changes represent careful thought and analysis on the part of many in the Agency, the Administration, and the Congress, and I believe that if enacted, they would strengthen not only the Agency's ability but also that of the States and local governments to more effectively address our nation's water quality problems. The fundamental philosophy underlying these proposals is that the structure of the Clean Water Act is basically sound and that changes, where they are needed, should be designed to improve the implementation of the Act and its objectives. By increasing the role of the States and providing them with more flexibility in addressing water quality problems, we believe those problems will be resolved more quickly and efficiently.

This concludes my statement. I would be happy to answer any questions you may have.

Mr. **Scheuer**. Thank you very much for your testimony, Dr. Hernandez. As you are aware, there is a rollcall vote going on, so we will suspend for 10 or 12 minutes so that the Members have a chance to attend that vote.

Mr. Hernandez. Surely.

[Short break taken.]

Mr. **Scheuer**. All right. The subcommittee will recommence its consideration of the Clean Water Act.

Congressman Carney?

Mr. **Carney**. Thank you very much, Mr. Chairman.

Dr. Hernandez, welcome. Dr. Hernandez, I want to apologize for being late to the meeting. I had to fly back to the district this morning, and with the weather the planes were backed up. At any rate, I did have the opportunity to read some of your testimony, and in it you stated that the EPA feels that it is the responsibility of the States to control water pollution and to enhance the quality of our Nation's water.

I wonder what it is that leads you to believe that the States have that capability and at the same time what would make you believe that they have the willingness to assume that responsibility.

Dr. **Hernandez**. Mr. Chairman and Mr. Carney, I think that is an excellent question. I think that the things that have happened since the 1972 Water Pollution Control Act that have come into play are good indications of that in terms of the States' abilities and desire to do these things.

The EPA got started by issuing regulations on a number of different things: For instance, secondary treatment, industrial controls, and the permit system. As time went on, beginning in approximately 1976 or 1977, a very concerted effort that has been continued to date to transfer these permitting programs to the States has taken place.

Right now, I think the number of States that have the permit program is on the order of 33 or so with more coming along. I think that is a good indication in our activities with the States. For them to accept this water quality permit program is indicative.

Another one of those areas is the construction grants program where we are building municipal sewage treatment plants. EPA took over and ran those programs initially in 1972. Over time, we are beginning to get those programs out to the States, too, and a number of States now run their own construction grants program.

The States have adopted water quality standards and have shown a strong interest in revising and reworking those water quality standards with our help. We have been working with 12 States on a pilot program to use site-specific water quality criteria in establishing those standards, and 3 more will be started by the end of this fiscal year.

Therefore, I think that there is a good history for their doing it and a good history for their ability to do it.

Mr. **Carney**. Is EPA prepared to step in and assume the responsibility for water quality protection in those States which choose not to protect their water supplies against pollution?

Dr. **Hernandez**. We are doing it right now. We run the permit programs for the ones which don't have them. Therefore, it is something which is ongoing and we are carrying out. However, I think that most States really do have that intent and do have the capability.

Mr. CARNEY. Those that have demonstrated that capability—is it EPA's intention to monitor those States in an oversight capacity to insure the Nation that they are living up to set standards?

Dr. HERNANDEZ. Yes, sir. We do this through a number of ways. When a State takes over a part of the permit program or the construction grants program, we have a couple of techniques for making sure that they in fact do run them in an efficient and effective way.

One of them is through the State-EPA agreements that are renewed each year where we review the progress they have made during the preceding year. We also monitor compliance with permit limits on a selective basis. We have them broken down into major effluent permits and so on. We monitor those things.

The man who runs this program is Eric Eidsness, and he might be able to give you some idea of the other checks that we have on that. Eric?

Mr. EIDSNESS. Good morning, Congressman. The EPA continues to review water quality standards that are revised by the States from a scientific point of view and a policy point of view. Also, we have instituted a program that is part of the Administrator's accountability system. Under this program, we meet with the regional offices and the States on at least an annual basis, to sit down with State directors and key staff people to review progress that each of these States is making and to try to pledge collectively our resources toward some focused goals to help States improve the administration of their various programs. This process has been up and running for some time.

Mr. SCHEUER. Would my colleague yield briefly?

Mr. CARNEY. I would be glad to yield, Mr. Chairman.

Mr. SCHEUER. On just exactly this point, both you and Dr. Hernandez have said that the States have both the willingness and the capability of carrying out their responsibilities under the Clean Water Act. Section 106 of the act provides for Federal funding of the water pollution controls which provides for the technical assistance, enforcement, training, and so forth.

Now, let's assume that the States do have the will and the savvy and the expertise to carry out these programs, given proper funding. You have increased their responsibilities, but you have cut their funding 20 percent without even factoring in inflation. With inflation, it would be closer to 30 percent from 1982 to 1983. At the same time, you have increased their responsibilities. Therefore, at the same time, you have loaded more of a burden on them. You have reduced their operating staffs and their professional staffs.

It seems to me that this can only have an adverse impact on State pollution control efforts even assuming that you are right that the States have the will and the capability of doing it. If you cut their funding by close to 30 percent and you have increased their responsibilities, how can you expect them to do even a marginal job with the increased role that you have given them?

Dr. HERNANDEZ. Mr. Chairman, I think that we have looked at the overall pot of money that is available for those water quality programs to the States, and 106 is one of the places that it comes from. There are also funds under the construction grants entitlement. Those grants have been increased. One of the places was $24 million provided under a new section of the act called 205(j). This particular one is to help the States set water quality standards. It is specifically identified for that purpose.

The other part of it is we have reduced——

Mr. SCHEUER. Well, now, on that point——

Dr. HERNANDEZ. Yes, sir.

Mr. SCHEUER [continuing]. Did those funds for construction—may they be applied by States to technical assistance, to training, to enforcement programs? If they are a line item for construction, would you permit States to use them for these other purposes?

Dr. HERNANDEZ. Sir, the money—the $24 million is very much in this water quality area. The 205(j) specifies that the States are to use that money for that purpose.

Mr. SCHEUER. For what purpose?

Dr. HERNANDEZ. For helping them determine their water quality needs and standards which is not a construction item, per se. The revised act gave the States 3 years to go back and review their water quality standards, and then it provided this block of funds for that purpose.

Mr. SCHEUER. Can they use those construction funds for the purpose of section 106: For permits, technical assistance, enforcement training and the like?

Dr. HERNANDEZ. There are some of those areas that they can.

Mr. SCHEUER. Well, which can they and which can't they?

Dr. HERNANDEZ. Mr. Eidsness?

Mr. EIDSNESS. Perhaps, I can elaborate, Mr. Chairman. There are three pools of funds—three sources of funds—that States can use under the Clean Water Act. One is the 205(g), and that is tied to the construction grants appropriations. Those funds are to be used primarily for the purpose of administering the construction grant program. However, should there be residual funds left over if a State doesn't need all of those funds for construction grants administration, it can use those funds for other activities such as monitoring and permits.

Mr. SCHEUER. Well, as a matter of experience, have many States or most States had funds left over from the construction grant program that they could apply then to these other purposes: Inspection, technical assistance, enforcement, training? What has the practical experience been?

Mr. EIDSNESS. Well, I think my understanding—I don't know the status of every State and where they are currently with their fundings right now—is since the funds under 205(g) are related to the construction grant appropriations, State directors have, I think wisely, not spent all these funds in any one given fiscal year because of the uncertainty of whether or not you are going to get the same level or adequate funding the next year under the subsequent construction grant authorizations.

Therefore, they have had carryover funds which have been able to continue their programs as they wait for hopefully an appropriation this year which would release the fiscal year 1982 construction grant funds. It would also release the 205(g) funds for administering the program and the 205(j) funds which are also tied to that appropriation which would go toward monitoring, technical assistance, permits, water quality management, and standards-related activities.

Mr. Scheuer. What you are saying is that over a period of years they have had such a feeling of insecurity and anxiety about the stability and the continuity and the continuing integrity of these programs that they have preferred not to participate in these programs.

Mr. Eidsness. No.

Mr. Scheuer. They have so little confidence in the ongoing reliability of the programs. Isn't that what you are saying?

Dr. Hernandez. No.

Mr. Eidsness. No. I think on the contrary they have been——

Mr. Scheuer. Now, I am not saying this is a partisan matter because, if that has been going on over the years, much of it went on under Democratic administrations as well as Republican. Therefore, maybe this is a bipartisan problem that has to be solved on a bipartisan basis.

Mr. Eidsness. I think that the evidence is to the contrary. The States over the years have grown and taken on more and more responsibility and developed the capacity within their own institutions to take on responsibilities for which the law gave them the primary right and responsibility.

Clearly, every institution of American Government right now is going through some belt tightening and the reprioritization in developing new management structures. EPA, the States, and the other agencies are doing the same thing.

We have instituted a number of reforms through our regulations and administrative procedures to try to ease the burden on the States to carry out these programs which will also have an effect of freeing up some of their resources. I would be glad to provide the chairman of the committee examples of that later on if you so request.

Mr. Scheuer. We would appreciate any documentation of what you have been telling us. We will be submitting some additional questions for the record relating specifically to these concerns. We would appreciate your prompt reply to these questions.

I might say that later today we are going to hear from a New York State representative of the Association of State and Interstate Water Pollution Control Administrators. Is Mr. Italo Carcich here today?

Mr. Carcich. Yes.

Mr. Scheuer. OK. Have you been listening to this discourse? Maybe you will give us your view as to whether States can function under the increasing burdens and the decreased cut in funding that is proposed—the 20-percent cut in funding—based on the availability of some funds from the construction program which States haven't used.

You know, this may be a case where less is more. We have heard a lot about less being more, but it seems to me that if the construction program is being administered properly over the years under the jurisdiction of several administrations of both parties, that States would have taken advantage of those programs on an ongoing basis, and there wouldn't have been anything else for other purposes.

However, you are going to submit some information, and we are going to hear from Mr. Carcich.

Mr. **Eidsness**. Mr. Chairman, may I add one thing just to clarify? If there is not an appropriation of the construction grant bill soon, the States will be in very serious trouble in my estimation because they will run out of whatever residual 205(g) funds they now are operating under. They would not have the use of the 205(j) funds for planning and standards and other related activities. Therefore, therein lies a very serious problem.

Dr. **Hernandez**. Mr. Chairman?

Mr. **Scheuer**. Well, we hope that this Congress very shortly will get out that authorization. Your point is very well taken.

Dr. **Hernandez**. Let me say a little more on more is less because I think what we are doing this year is providing——

Mr. **Scheuer**. No. What I was suggesting that this reflects is a policy of less is more.

Dr. **Hernandez**. I know that. I was going to say that we are actually providing more money in the total pool this coming year in the water quality programs and construction grants programs.

I don't remember the exact numbers, but the 106 moneys have been on the order of $50 million. We suggest they should be on the order of $41 or $42 million, a decrease of something like $8 or $9 million in the water quality area.

The States will have $24 million available to them for water quality related work out of 205(j). The actual load on the construction grants program under 205(g) will diminish because the amount of money available will only be $2.4 billion, and in the past it has been $3.5 billion to operate.

Mr. **Scheuer**. I am going to yield back to my colleague, Congressman Carney, of New York to continue his questioning.

Mr. **Carney**. I think that my 5 minutes are up. Thank you, Mr. Chairman.

I kind of lost track of the question that I had asked. However, what I would like to get back to, in a different vein, Dr. Hernandez, is this past Tuesday, the USGS testified that there is no way that one could state that water quality has improved over the last decade. You, in your statement today, felt very strongly that, indeed, water quality has improved over the past decade. I was wondering if you could respond to that discrepancy that we see.

Dr. **Hernandez**. Yes. I am sorry that I did not read and hear their testimony, so I cannot comment on what they said. Let me put it in the context of how we measure improvements in water quality. In my testimony, we said that wastewater treatment plants are coming into compliance, something like 76 percent of them are coming into compliance. Therefore, the pollutants that we are looking at are those conventional kinds of pollutants that come out of municipal and industrial treatment plants. The compliance with those permits has greatly increased so that the amount going into the streams is far less. Therefore, water quality will be improving.

Now, it is very difficult to notice some of these improvements except in some rather surrogate ways, and let me just mention a couple of those things. One of them is a decrease in some toxics in fish that we have observed over the years. DDT is one of those things that people were quite concerned about in the early 1970's. Over time, DDT levels in fish have gone down markedly. There has been some decrease in PCB's in fish just since the ban has taken place. Therefore, there are noticeable things like that.

I think that one of the ones—and I don't mean this in a funny way at all—there are cases now where you could never find a fish kill in certain waters in the past because fish just didn't live there. They just didn't go there. Now there is an occasional report of them because they are now moving into these areas for most of their life cycles. We are finding many water bodies which have become fishable and swimmable.

Therefore, I think that in terms of the kind of EPA criteria, we have seen a marked increase in the quality of water.

Mr. **Eidsness**. Congressman, if I could clarify one point, I think John is talking primarily about surface waters.

Mr. **Carney**. Yes.

Mr. **Eidsness**. I think we have to admit that, because the focus historically has not been on ground water, that neither the Agency nor anyone else seems to know what the trend has been over time. One could presume that ground water in certain areas is becoming more contaminated. We have instituted a number of monitoring studies. Some are ongoing. Some are just concluding. They are intended to try to get a better fix on what is the status of the quality of ground water, and it is to help us to work with the States in developing some effective preventive and control programs.

Mr. **Carney**. The chairman tells me that my time is running down, and I will at this point yield back to him.

Mr. **Scheuer**. I recognize the lady from Rhode Island.

Ms. **Schneider**. Thank you, Mr. Chairman. I am interested in discussing a little bit of the water quality research program plan that has recently been issued.

I wonder if you could elaborate a bit as to how this plan was developed and the process that was used in bringing it about.

Mr. **Scheuer**. You might also inform us as to why your Science Advisory Board was not requested to comment on the plan because under the statute you are required to send us the plan along with the comments of your Science Advisory Board, and this was not done.

Dr. **Hernandez**. I think that I will take them in two parts, and I will discuss the formation of the plan first. Then we will come back and give you some specific comments on the process that we have come to you with.

Mr. **Scheuer**. And why the Science Advisory Board——

Dr. **Hernandez**. Yes, sir.

Mr. **Scheuer** [continuing]. Was not involved and why we did not receive the comments of the Science Advisory Board on that plan as is specifically, clearly, and unmistakenly set forth in the statute.

Dr. **Hernandez**. Yes, sir.

Mr. **Scheuer**. Please proceed.

Dr. **Hernandez**. Yes, sir.

Congresswoman, the basic process followed in EPA on the development of our overall research plan, whether it is the water quality one or not, is to work with ORD research, working with the research committees in the various programs as they discuss results from ongoing activities and future needs as they are reviewed. Therefore, it is a continuing dialog that goes on in kind of a give-and-take fashion.

We have been negligent in not getting this plan to you in a much quicker fashion.

Mr. **Scheuer**. Let me just footnote that——

Dr. **Hernandez**. Yes, sir.

Mr. **Scheuer** [continuing]. Remark for the record. The statute also provides that you are to get that plan to us 2 weeks after you submit your budget which is in February. Now, instead of it being the end of February or early March, we are now into June.

The second problem that we have is, even with this 4- or 5-month delay, we still didn't have the comment of your Science Advisory Board as is required in the statute.

Dr. **Hernandez**. Yes, sir.

Mr. **Scheuer**. Please continue.

Dr. **Hernandez**. Yes, sir. The process of doing this started virtually back in July a year ago. When you start doing the 1983 budget, you start looking at what we are going to propose and what we are going to do and the kinds of things that go on. The first draft of the research plan that we have I saw sometime in November, and I found it to be redundant, full of bureaucratic words, not explicit as to what we were going to do, and I felt that it really didn't answer the kinds of questions that I felt we should address not in specifics but in the kind of general format of how it was made up.

Ms. **Schneider**. Do you believe that the plan now answers those questions?

Dr. **Hernandez**. I think that we have done a much better job. I am still not content when I read it and look at it and say, "What does that mean?" I want the people who are looking at it to clearly know where we are going and the kinds of priorities that we have and that sort of thing. However, I think it is much better than we have done in the past. It has taken us a long time, and it has gone through iterations within the program.

One of the things that I am pleased to say specifically with respect to the water quality aspects of the program is the program people have developed their priority list. When compared to what turns up in the research strategy, I think that virtually those items are included in there and that over the next 3 or 4 years we will in fact generate the kinds of information that they need in addition to the things that I would call the futuristic things—looking down the road to help us as we move in the 1985-86 era. Therefore, I am pleased about the process even though we have taken a long time.

Ms. **Schneider**. OK. Let me ask you how many members are on the Science Advisory Board?

Dr. **Hernandez**. Well, there is the executive committee and then there are four other committees of the Science Advisory Board. These four other committees—one of them is the CASA committee for clean air. The other 3 would have some kind of specific review with respect to water quality.

Ms. SCHNEIDER. Right, but in total, how many members are there altogether.

Dr. HERNANDEZ. Oh, I would guess about 40.

Mr. YOSIE. Sixty.

Dr. HERNANDEZ. Sixty.

Ms. SCHNEIDER. Sixty members. How many of those seats have been filled at this time?

Mr. YOSIE. Let me elaborate if I can. The administrator in the last 2 or 3 months has appointed twenty-three engineers and scientists to the Board.

Ms. SCHNEIDER. OK, so there are now on board 23 out of 60?

Mr. YOSIE. No, there are about 53 members currently on the Board.

Ms. SCHNEIDER. All right.

Mr. YOSIE. And they serve on the various committees that Dr. Hernandez just mentioned.

Ms. SCHNEIDER. And are those 23 new appointments and the remainder carryovers from the last administration?

Mr. YOSIE. That is correct. I might add, though, that of the 23 some have previously served on the Board.

Ms. SCHNEIDER. OK. Let me ask you about the makeup of some of those new appointees—of those 23. I would like for you to list for me a couple of the backgrounds—the industries that these various scientists and engineers had worked for prior to their appointment to this administration's position.

Mr. YOSIE. OK. Of the 23, three are employed by industry. The rest——

Ms. SCHNEIDER. What were those three industries?

Mr. YOSIE. Let me just review this.

One is General Mills.

Ms. SCHNEIDER. Could you please tell me what his or her background or qualification is?

Mr. YOSIE. The person who was appointed from General Mills is Dr. J. William Haun who testified before this subcommittee, I believe, in February or March of this year. He is vice president for engineering policy. He has also served as chairman of the International Center for Industry and the Environment which is a consultant body to the United Nations environment program.

The other industry appointee is Dr. George Green who is manager of licensing and planning for the Public Service Co. of Colorado. Dr. Green is a mechanical engineer who has a great deal of expertise on issues like visibility.

The third appointee employed by industry is Mr. Richard Conway of Union Carbide Corp. Mr. Conway is a civil engineer who is an expert in water pollution control processes, solid and hazardous waste disposal, and environmental risk analysis.

Mr. SCHEUER. Let me just interrupt my colleague briefly at this point.

Ms. SCHNEIDER. Surely.

Mr. SCHEUER. I don't think there is anybody on this subcommittee or on the full committee who thinks there is anything wrong with having qualified representatives from industry. In fact, there is a great deal of expertise in industry. There is a great number of very distinguished scientists whose input is not only appropriate but necessary in the Science Advisory Board.

I think what we want to assure is that there is a balance on the Science Advisory Board and that consumers are represented, industry is represented, the Government in effect is represented, academia is represented, and that when we get the views of the Science Advisory Board we can feel that they have taken a good, integrated comprehensive look at the problem.

However, surely, industry must be represented, and we welcome and value the contributions of industry representatives who are qualified scientists. I am sure that we all feel that way.

Mr. YOSIE. As you know, Mr. Chairman, the scientific community is a very diverse body which encompasses a great number of schools of thought, and our criteria for selection of members to the Board has been to try to make the Board representative of that broader diversity within the scientific community.

Mr. SCHEUER. I think that a fair balance of all points of view is the leitmotif. That is the keystone here of the arch of the Science Advisory Board.

Mr. YOSIE. I might add that various members of the Science Advisory Board who were appointed during this administration have testified before this subcommittee two days ago. Doctors Rolich and Loehr testified.

Ms. SCHNEIDER. Yes.

Mr. YOSIE. I think that in the spring of this year, Dr. Julius Johnson had appeared, Dr. Roger McClellan, Dr. Morton Corn. You will hear today from Dr. Ernest Gloyna. I think those are certainly eminent scientists and engineers.

Ms. SCHNEIDER. OK. I would like to ask Dr. Hernandez about the recent annual report by CEQ that made the point that nonpoint source water pollution accounts for 50 percent or more of this country's total water pollution. Yet, in looking at the budget, EPA has drastically reduced—actually almost terminated—the nonpoint source pollution research.

Now, I wonder how, when we are getting the recommendation or analysis by CEQ, the other arm of the Government can be taking a step in the opposite direction?

Dr. HERNANDEZ. Yes. I think that is a good question because, as I indicated in my testimony, as we get municipalities in compliance and we get industry in compliance, which is going down the line in a good fashion, we need to turn to those other things that keep us from meeting the State water quality standards in each segment of the stream system.

Many of those things, as you have indicated, are out of those nonpoint sources.

Ms. SCHNEIDER. But how do we get 50 States into compliance when we have so dramatically cut enforcement?

Dr. HERNANDEZ. Let me go ahead and address the nonpoint source. The enforcement is doing pretty well. However, let me address that problem of nonpoint sources.

The law—the Clean Water Act—visualizes a State identifying nonpoint sources, and, where they feel it is necessary, set some kind—develop some kind of a program to control those things.

I think a good example would be phosphorus coming in off of either municipal areas or rural areas—farm areas—into stream systems causing eutrophication.

What we have done is we have had a large number of both research studies and demonstration studies to show people how to control these nonpoint sources.

Mr. **Scheuer**. Excuse me. Yes, but you have just eliminated your nonpoint source research. How can you continue this ongoing program when you have had an absolute cessation of the basic research that is the sine qua non? Knowledge is the sine qua non of ongoing efforts in pollution control of nonpoint source pollution.

Mr. **Hernandez**. Basically, all——

Mr. **Scheuer**. Do you feel that we know everything that we have to know to do the job?

Dr. **Hernandez**. To do those kinds of things that States can and should do in terms of controlling nonpoint sources, the answer is yes. These are the conventional kinds of things. These are like silt. They are like organic matter that falls off of trees and vegetation. They are phosphorus that comes into the stream systems out of farming operations. They are runoff from urban areas. In each of these areas we have had major EPA programs to analyze it, to give people the kind of background that they need to know in terms of control.

Mr. **Scheuer**. Yes, let me just tell you that this has been a flat—what you are telling us now has been an absolute flat contradiction to what Dr. Loehr told us on Tuesday. He told us that we need to know a great deal more than we know now in order to extend these controls effectively and efficiently.

We have heard insistent demands from industry and from the administration that any regulatory effort or any regulatory agency from here on in has to be more sensible and has to be better fine tuned than they have been up to now. We cannot impose unreasonable regulations on industry where the benefits aren't clearly superior to the costs.

Now, we accept that. Congress feels that strongly. The one tool that we need in order to be cost effective, in order to make sure that we don't load unnecessary costs for pollution-control efforts industry is knowledge. Knowledge is power. You have heard that before. Knowledge is also cost effectiveness. At a time when we urgently want to continue improving our ground water quality—we had hearings up in Congressman Carney's district last year, and we know the desperate urgency of that problem in his district. When we want above all to avoid doing silly things that needlessly cost industry money, when we must finetune our standards and our regulatory approaches, at that very time, you are eliminating the possibility of improving our knowledge base, improving our data base. That, to us, is very troublesome. We had extensive testimony on Tuesday on this subject, and I doubt very much that we have heard the last of this subject. This is a matter of deep concern, I take it, on both sides of the aisle.

Ms. **Schneider**. Mr. Chairman, I just might add that it does concern me when Dr. Hernandez said that the State will develop some kind of a program. What that leads me to believe is how would it be physically and financially possible for the State to develop a program, and even if it had the financial wherewithall and the Federal Goverment were to enforce it, what is the carrot-and-stick approach?

The Federal Government can't say, "We will give you some money to develop this program," because those funds have been cut. Therefore, I don't understand the flow of logic to implement a program to get rid of nonpoint source pollution.

Dr. **Hernandez.** You know, I think that we have kind of gotten off the track.

Mr. **Scheuer.** Excuse me. We do have a rollcall vote going on. We will suspend for about 10 or 12 minutes.

[Short recess taken.]

Mr. **Scheuer.** All right. I think when we recessed, Congresswoman Schneider was just winding up some remarks. Do you wish to proceed further, Congresswoman Schneider?

Ms. **Schneider.** No, Mr. Chairman.

Mr. **Scheuer.** All right.

Dr. Hernandez, were you in the process of answering her questions or my questions? Do you wish to comment further?

Dr. **Hernandez.** No, sir. I think that, while I am loath to have any kind of disagreement with a fellow academician like Dr. Ray Loehr—I have known Ray for many, many, many years—I did not read all of his testimony. I read a summary of it. I don't find that we are that basically in doubt. I think that in terms of State regulatory programs, our information on nonpoint sources is sufficient for States to take action and to regulate these things.

I think that from an academic point of view we can always go on learning. The more we know, the better off we are, and the point you raised is certainly a valid point.

Mr. **Scheuer.** Well, we will hear from the representative of the States——

Dr. **Hernandez.** Surely.

Mr. **Scheuer** [continuing]. As to whether they feel that they have an adequate data base now to regulate, not with a shotgun, but with a high-powered rifle and an 8-powered scope. That is what society wants us to do.

Dr. **Hernandez.** Yes.

Mr. **Scheuer.** That is certainly what President Reagan wants us to do. The one thing that we need to have in order to function and to perform our job is knowledge.

Dr. **Hernandez.** Yes, sir.

Mr. **Scheuer.** I guess that the final word isn't in as to whether our present data base is sufficient for us to do the job competently.

You do mention in your testimony that technology-based controls will not be sufficient to achieve State-developed water quality standards in all stream segments. Why is this?

Dr. **Hernandez.** They were not designed to do that. They were designed to provide that fundamental base that everybody had to do regardless of the benefits achieved. We weren't trying to say that this town on the Mississippi doesn't need to provide secondary treatment. Everybody has to provide secondary treatment. It was that fundamental base. Beyond there, we had the water quality approach.

Mr. **Scheuer.** Dr. Hernandez, we are way behind schedule.

Dr. **Hernandez**. Yes, sir.

Mr. **Scheuer**. We very much appreciated your testimony, and your obvious efforts to be forthright and candid in answering our questions. We do have some more questions, but I am afraid that we are going to have to wind this up if we are going to get to our last panel.

With repeated thanks to all of you for your sincere testimony, we will move to the next panel, and we will ask you to wait expectantly for some of our written questions. Thank you.

Dr. **Hernandez**. Thank you, sir. It is always a pleasure to be here with you, sir.

Mr. **Scheuer**. It is a pleasure having you.

Mr. **Scheuer**. Now, we will hear from our final panel representing industry, States, and the municipalities. There are four panelists: Dr. Ernest Gloyna, vice president of Water Pollution Control Federation; Mr. J. David Thomas, Chemical Manufacturers Association; Dr. Cecil Leu-Hing, Association of Metropolitan Sewerage Agencies; and Mr. Italo Carcich, representing the Association of State and Interstate Water Pollution Control Administrators.

Will you all come up and take your seats at the table? Let me say as you are getting settled that your statements will all be printed in full in the record following your oral remarks.

At this point, since there are six of you and we really only have a half hour left—we will go overtime anyway—I will ask you to restrict your statements to 5 minutes. That will give us some time for questions.

What I would suggest, going off the record——

[Discussion off the record.]

Mr. **Scheuer**. Going in the order in which I invited you up, first, we have Dr. Ernest Gloyna.

STATEMENT OF ERNEST GLOYNA, VICE PRESIDENT, WATER POLLUTION CONTROL FEDERATION, ACCOMPANIED BY JACK NEWBOULD, PRESIDENT, WATER POLLUTION CONTROL FEDERATION; AND ROBERT CANHAM, EXECUTIVE DIRECTOR, WATER POLLUTION CONTROL FEDERATION

Mr. **Gloyna**. Good morning, Mr. Chairman and committee members. I am Earnest Gloyna, vice president of the Water Pollution Control Federation. With me today is Jack Newbould, president of the federation, and Bob Canham, executive director.

We represent an organization of about 30,000 members. We have 44 member associations in the United States and another 21 associations worldwide.

The basis for the discussion today are two reports that have been prepared by the federation. These reports will be made available to the committee members in the proceedings. These reports describe research and development in two major areas: One in the sludge disposal area and another in the toxic pollutant control area.

In this connection, I would like to describe the essence of these two reports because we have historically had a keen interest in the sludge-management problem, particularly in the research and development area.

Considering the amounts of sludge that are being produced and the changes in the quality of the sludge, this is an important area. Today, the lack of prior research handicaps our efforts in improving the effectiveness of our management program. We need to learn more about the fundamental properties of sludges and the factors that influence them. We need to develop ways to alter these properties, and we need to develop better techniques for reclaiming the useful constituents in the sludges.

Now, in our prepared text, we have listed 16 major areas that should receive considerable R&D attention. The research activities that need to be addressed in the toxics area are also in the report. Our current state of knowledge does not allow for a comprehensive listing of toxic substances or well-defined discharge limits for them.

The reason that our research committee focused on the needs to apply, to identifying and controlling minute quantities of different categories of substances such as metals and organics and other materials are also defined in my text. We can divide the list of research needs into three general categories. They are the monitoring strategies for specific substances, the detection and measurement of specific substances in wastewater suspension and residues, and the discovery of the fate of substances in the physical, chemical, biological operations, and processes used in our wastewater and sludge treatment processes.

Dealing with toxics presents 20 specific research needs and interests. While I am on the subject of water quality research, let me turn my comments to a specific topic of land and ocean disposal of municipal sludges. This is a management alternative for which there is a growing scientific basis and considerable support. A blanket ban on either ocean or land disposal in our opinion is counterproductive.

Now, I would like to be a little more specific about the nature and value of research. Research, whether it is directed toward an engineering or scientific solution, is basically incremental in nature. When the spotlight is turned on to a given area such as toxic pollutant control, our profession can only respond with the best information at hand. It cannot manufacture answers at will.

In this connection, I would like to make four points. One, research and development has a relatively long leadtime and payoff record. Two, R&D may not always produce the immediate intended results. This should not be discouraging. It is a fact of life. Three, R&D is sometimes hard to coordinate with the short-term needs of specific control programs. The relationship between a program and attendant research efforts is and must always be dynamic in nature. Four, R&D is often difficult to restart once it is stopped.

Now, having said all of these things about the research question with emphasis on sludge and toxic materials, let me offer three conclusions in support of what we consider to be the enhanced R&D effort.

First, R&D takes time, but it always buys time. It is our way of identifying future pollution-control problems. As such, it gives us valuable time to prepare to meet them before they get out of hand.

Two, R&D helps us train people who will be needed ultimately to solve the problems.

Three, R&D will indicate to us where we should go next. It shows us the gaps. It shows us the unanswered portion of our problem. It helps us figure out the paths we must undertake first, and it gives us an insight into the future.

Mr. Chairman, this briefly summarizes my statement. The additional points that are in the statement are quite specific and succinct. I will be very happy to attempt to answer questions that you may wish to submit.

[The prepared statement of Mr. Gloyna follows:]

DR. EARNEST GLOYNA

VICE PRESIDENT, WATER POLLUTION CONTROL FEDERATION

Good morning, Mr. Chairman and committee members. I am Dr. Earnest Gloyna, vice president of the Water Pollution Control Federation and Dean of Engineering at the University of Texas at Austin. With me are Mr. Jack Newbould, president of WPCF; Mr. Robert Canham, WPCF executive director; and Mr. Andrew Ellicott, the Federation's public affairs manager.

The Water Pollution Control Federation is a nonprofit membership organization devoted to developing and distributing information on the nature, collection, and treatment of wastewater. WPCF is composed of 44 member associations in the U.S. and Canada, and is affiliated with 21 other similar organizations around the world. Approximately 30,000 people belong to WPCF through member associations or directly.

Our members come from every point in the spectrum of professional water pollution control. We do not represent any one interest in the field and we do not accept grants or contracts for our activities. The vast majority of the information we develop and publish each year, from our monthly journal to our training courses, is written by individuals and committees who volunteer their time. Whatever stature we have attained in the environmental protection field is due largely to the energy and dedication of our members.

The Federation appreciates your invitation to testify before this committee, today Mr. Chairman. It is my privilege to present two detailed reports on research and development needs recently prepared by the Federation's research committee. That committee began working on these reports in 1977, after meeting with officials from the Environmental Protection Agency for a series of discussions about research and development needs in the water pollution area. WPCF decided to concentrate on research and development needs in the areas of toxic pollutant control and sludge control. After five years of painstaking work we have completed both reports. We are submitting draft copies to you this morning and will supply finished copies as soon as they are printed. Today I want to summarize each report briefly and add some observations of my own about water quality research needs.

Research & Development for Sludge Management

Historically, municipal sludge management has received a disproportionately small share of R&D attention, considering the increasing amounts being produced and the changes in quality. If there is more of a "sludge management problem" today than there was a decade ago, it is largely because we have improved water quality by removing more pollutants from the wastestream. Many of the techniques used to treat and manage sludges today were developed piecemeal. Today this lack of prior research handicaps our efforts to improve the effectiveness of sludge management.

We need to learn more about the fundamental properties of sludges and the factors that influence them. We need to develop ways to alter those properties to improve sludge treatment processes. And we need to develop better techniques for reclaiming the useful constituents in sludges. Our Research Committee's report on R&D needs in the sludge management area goes deeply into the detailed research that should be done. Here are a few of the highlights that illustrate the variety of our major needs.

1. Conduct fundamental studies of the surface properties of particles contained in sludge, the factors influencing the physical properties of sludges, and the means for controlling those properties.

2. Develop reliable means for predicting the quantities of sludge produced in wastewater treatment.

3. Improve our understanding of the sources of heavy metals, toxic organic compounds, and other constituents in municipal wastewaters.

4. Develop better understanding of the influence of return streams from sludge treatment on wastewater treatment plants.

5. Seek techniques for predicting sludge thickening and dewatering performance on the basis of fundamental and readily measurable sludge properties.

6. Relate the molecular structure of sludge constituents and environmental conditions to the performance of biological sludge stabilization processes.

7. Conduct a rigorous analysis of energy, moisture, and mass balances in sludge composting and carefully evaluate the economics of the process.

8. Develop the epidemiological evidence required to assess the advisability of using processes for inactivating organisms and viruses in sludges.

9. Develop better means of detoxifying those sludges that require such treatment.

10. Improve understanding of the flow behavior of various types of sludges so as to improve pumping and piping system design capability.

11. Develop means for sensing and controlling odors from sludge management facilities.

12. Develop means for harvesting useful constituents from sludges.

13. Seek a better understanding of the cycling of sludge-borne trace constituents in agricultural land application sites and develop control techniques for those cycles.

14. Evaluate the fate of sludge constituents in landfills and develop control techniques for them.

15. Establish the fate and effects of sludge constituents in the ocean through rigorous studies involving careful mass balance calculations.

16. Develop relative risk assessment methodologies to permit more rational decisions on alternative means of sludge management.

The research needs I have just described are the tip of the iceberg in the area of sludge management. To complete any one of these successfully within the near future would require a number of different researchers and research teams working in coordination on different facets of the general problem. The same is true of the needs reported in the Research Committee's investigation of toxic pollutant control, to which I will now turn.

Research & Development for Toxic Pollutant Control

Human exposure to toxic substances occurs through a complex network of sources that includes: air, land, and water pollution; food and food additives; tobacco products; pesticides; drugs, cosmetics, and other consumer products; and industrial work environments and accidents. Unfortunately, professionals in the water pollution control field are not typically trained in toxic assessment, so the integration of these two disciplines is still going on. Our current state of knowledge does not allow for a comprehensive listing of toxic substances or well-defined discharge limits for them. For this reason our Research Committee felt it was impractical to list the R&D needs for specific compounds. Instead, it focused on the needs that apply to identifying and controlling minute quantities of different categories of substances such as metals, organics, and others.

We can, however, divide the complete list of research needs into three general categories. They are: monitoring strategies for specific substances; detection and measurement of specific substances in wastewater suspensions and residues; and discovery of the fate of substances in the physical, chemical, and biological operations and processes used in wastewater and sludge treatment. The following needs are some of the highlights of the Committee's report on toxic pollutant control.

1. Build a comprehensive national monitoring strategy that minimizes redundancy and maximizes interaction between state and federal regulatory agencies. A major objective within this need should be improving information transfer between government agencies and an

increase in the public's access to information collected on specific substances.

2. Establish a national monitoring advisory committee composed of public and private members to periodically review the national monitoring program.

3. Define objective detection limits for specific substances in clean water and set quantitative limits below which analytical results would be insignificant.

4. Define the differences between analytical capabilities in clean water and in complex wastewater and sludge samples.

5. Develop cost-effective quality-control procedures for measuring specific substances in water, wastewater, and sludge samples.

6. Simplify the operation and maintenance of gas chromatographic (GC), mass spectrometric (MS) and associated data analysis systems so we can develop cost-effective analytical instrumentation for trace organic measurements.

7. Identify how mixing and aeration strip specific substances from wastewaters into the atmosphere.

8. Identify the factors that control the rate and extent to which substances are stripped from multicomponent wastewaters and sludges and laboratory- and full-scale examinations.

9. Identify the impact of stripping on biological kinetic parameters and the ultimate assessment of the biodegradability of specific substances.

10. Examine in detail how specific substances concentrate on the surfaces of wastewater particulates, sewer lines, coagulant floc-particles, and suspended and attached biological solids has significant impact on performance of numerous processes.

11. Find ways to reliably control the adsorption of specific substances at levels of 100 Mg/1 and less in systems such as activated carbon.

12. Develop more data and better models of how adsorption systems perform in complex wastewaters and of the long-term effects of regenerating such systems.

13. Determine the role of adsorbents in aerobic and anaerobic biological reactors.

14. Investigate sludge thickening, filtration, and dewatering systems to determine the extent to which specific substances are removed with sludge solids or are discharged with residual liquid.

15. Investigate specific substances by sedimentation in conjunction with those variables that affect substance solubility and sorption characteristics.

16. Develop methodology to determine the toxicity and degradability of specific substances by mixed microbial populations.

17. Expand current research into the quantities of specific substances and the associated treatment conditions that may inhibit anaerobic methane-producing microorganisms.

18. Investigate how coagulating and conditioning chemicals affect specific substances to see if their solubility, chelation, precipitation, and adsorption characteristics are changed.

19. Research the removal of heavy metals by alkaline precipitation and sulfide precipitation. Emphasize how process variables change metal removal and the thickening, dewatering and leaching properties of sludge.

20. Research the chemical oxidation and halogenation of specific substances in single- and multi-component solutions and suspensions.

Research for Water Quality Purposes

While I am on the subject of water quality research needs, let me turn to the subject of land and ocean disposal of municipal sludge. Controlled use of land and ocean application of municipal sludge is a management alternative for which there is a growing base of scientific support. Yet, ocean disposal of sludge is a topic that produced more heat than light during the 1970's. The Marine Protection, Research, and Sanctuaries Act limited the disposal at sea of residuals that could cause significant harm to ocean ecosystems. This was and is a worthwhile goal. Yet the provisions of the act were applied to ocean disposal of wastewater solids without allowing for research into the question of whether the disposal of particular sludges from different metropolitan areas would cause significant harm. A blanket ban of this form of disposal was counterproductive because it prevented coastal communities from objectively evaluating all of the different alternatives available to them for sludge disposal. If the balance of environmental benefits and costs is better for a land-based disposal system or for incineration, then ocean disposal should not be used. But if the balance shows ocean disposal is the least harmful alternative, then it should be chosen. Since 1976, WPCF has taken the position that ocean disposal should be considered on its merits. This seems to be what U.S. District Judge Abraham Sofaer said in April 1981. He ruled that EPA must consider whether or not the marine environment is unreasonably degraded by ocean disposal.

The Nature and Value of Research

Research, whether directed toward engineering or scientific solutions, is incremental by nature. When the spotlight of public concern is turned on a given area such as toxic pollutant control, the profession can only respond with the best information at hand. It can not manufacture answers at will. If we are lucky some foresight has been exercised; the problem has been identified by the scientific community some years before; work was started; and some productive results can be offered. Therefore, it is important that you who are concerned with our general ability to respond to environmental pollution control needs appreciate four characteristics of any form of applied R&D.

One: R&D has a relatively long "lead time" or "pay-off period." Our two reports are good examples of this characteristic. It took our volunteers nearly five years to survey what was going on; assemble the information to identify the gaps; determine roughly what needed to be done given our general objectives; and then write it all out. Research is like that. It builds on work done in the past and shapes work to be done in the future.

Two: R&D may not always produce the intended results immediately. This should not be surprising, nor should it be discouraging. Eliminating the false leads and the wrong hypotheses is a natural part of finding the right ones. The success of a particular research effort should not be gauged by the number of times one has to start over, but by the value of what one finds or creates when successful.

Three: R&D is sometimes hard to coordinate with the short-term needs of specific control programs. Because of the first two characteristics, an accurate estimate of when results should be expected is often hard to produce. The relationship between a program and its attendant research effort is dynamic. Sometimes the program will drive research. Sometimes research will drive the program. It is difficult to predict precisely how the two will dovetail very far into the future.

Four: R&D is often hard to restart once it is stopped. Like many creative enterprises, research relies on a good measure of art and intuition. It may take time for a hunch about what to try next to ripen in a researcher's mind. If he stops one project and starts another before the hunch forms, he may never make the intuitive leap his work has prepared him for and precious time can be lost when someone else has to pick up the ball. Then too, there is the very practical problem of training enough people to keep a given research effort going. As the Dean of Engineering at the University of Texas in Austin, it would be very hard for me to sincerely recommend that graduate student pursue a line of study if public and private support for it are being sharply limited.

Having said all of these things about its characteristics, let me conclude by stating the values of research and development.

One: R&D takes time, but it also buys time. It is our way of identifying future pollution control problems. As such, it gives us valuable time to prepare to meet them before they get out of hand.

Two: R&D helps us train the people who will be needed to solve future problems. We need to continue our research efforts wherever possible so that we can cultivate the knowledge and personnel that will be needed when the problems come.

Three: R&D indicates where we need to go next. It shows us the gap in our knowledge, helps us figure out which one to fill first, and gives us a tantalizing peek at what we could do if only we knew more.

Gentlemen, this concludes my testimony. I have enjoyed being here to present it and I will be happy to answer any questions you might have.

Mr. **Scheuer**. Thank you very much for your very wise counsel. We appreciate it. I am going to ask you later on, when we get to the question period to comment on who you think should do all this research. I take it that your organization represents both States and counties, as well as private industry. Is that correct?

Mr. **Gloyna**. Yes.

Mr. **Scheuer**. You feel that more research is needed, a better data basis is needed, and a more ample knowledge base is needed. Considering your knowledge of industry capability and industry will, the question is where most appropriately should this research be done and who should direct it and who should pay for it.

However, we will get to that later. I very much appreciate your testimony.

All right, our second witness is Mr. J. David Thomas representing the Chemical Manufacturing Association.

Please proceed Mr. Thomas.

STATEMENT OF J. DAVID THOMAS, CHEMICAL MANUFACTURERS ASSOCIATION

Mr. **Thomas**. Good morning, Mr. Chairman and members of the subcommittee. My name is David Thomas, and I am a civil engineer with Tennessee Eastman Co., Division of Eastman Kodak Co. Today, I am speaking on behalf of the Chemical Manufacturers Association or CMA.

We recognize the need for basing environmental decisions on sound research. Good science, subjected to peer review, is essential to identify the environmental areas of concern and to identify appropriate solutions.

For example, in the absence of adequate scientific data, it was assumed that priority pollutants, as identified in section 307 of the Clean Water Act, were commonly present in and posed a serious threat to the Nation's waters. However, evidence today suggests that such concerns are largely unfounded. The December 1980 report of the Subcommittee on Oversight and Review of the Committee on Public Works and Transportation, U.S. House of Representatives, states and I quote:

> The latest information indicates that the 129 priority pollutants on which the clean water regulatory program is primarily focused are less evident in both amounts and concentrations than previously believed. And, to a degree not anticipated, the conventional secondary treatment technologies employed by municipalities and many industries have succeeded in removing most of the priority toxics in a highly efficient manner.

The President's Council on Environmental Quality makes a similar observation in its 1982 report entitled "Environmental Trends."

To quantify these observations with respect to the chemical industry, a joint cooperative EPA/CMA study was initiated in the fall of 1980. Such joint studies can be effective vehicles for answering important environmental questions.

I am now going to skip, at your request, to page 10 of my prepared statement and just give you the summary.

The results of the five-plant study were compared with other available technical information on the removal or organic priority pollutants by biological treatment. These comparisons concluded that the five-plant study data base is consistent with other data collected to demonstrate the performance of biological treatment systems for removal of organic priority pollutants. Available technical data document that the organic priority pollutants are generally biodegradable and that they can be removed by a properly designed and operated biological treatment system.

The comparative analyses also demonstrated that the state-of-the-art analytical methods used for the five-plant study have improved precision as compared to the levels observed during the EPA screening phase study of the organic chemicals industry.

The study clearly demonstrates that biological treatment systems identified as best practicable technology [BPT] for organic chemicals industry point source category provide a high level of removal of most organic priority pollutants. Based on the data collected during the five-plant study, there is no scientific reason to require additional categorical treatment technology for this industry. If any additional controls are required for any specific organic priority pollutants, they should be selected and applied on a case-by-case basis taking into consideration the treatability of the specific pollutant in question.

The study results show that the indicator pollutant concept is not generally applicable to the treated effluents from plants in the organic chemicals industry.

CMA believes that the five-plant study represents an important direction for future EPA research and development efforts.

First, let me again stress that this was a cooperative and voluntary research and development program funded jointly by EPA/CMA and the participating companies. This cooperative approach to scientific research efforts is welcomed by the chemical industry.

Second, the five-plant study included a comprehensive quality control/quality assurance program. Such a program is critical to evaluating the results of any research and development program. Continued quality control/quality assurance is essential if regulatory agencies and industry are to produce useful scientific data.

Third, the data base generated by the five-plant study demonstrates the value of a long-term sampling and analysis program in scientific investigations. Because of the high variability inherent even in state-of-the-art sampling and analytical methods, results based on a limited number of samples can lead to completely erroneous conclusions. To improve the validity of removable and treatability values, a long-term data base such as that provided by the five-plant study is needed. EPA should implement additional research and development projects to develop other long-term data bases.

Finally, CMA concurs with both the U.S. House of Representatives and CEQ reports that priority pollutants are not commonplace. The five-plant study results verify this finding. To further confirm this, CMA recommends that EPA undertake a comprehensive analysis of the effectiveness of current control technology. One possible direction of such an analysis would be to intensely study the ambient condition of the Nation's waters. If the study reveals that water quality problems exist despite inplace technology, then the study should also address how any such problems might best be alleviated taking into account the scope of the problems and the cost-benefit considerations. Attached for the record to our written statement are other specific research recommendations.

CMA takes pride in its participation in the five-plant study project. We believe that the results of the study add important new information to EPA's data base. We also believe that the five-plant study can be a harbinger of the direction of EPA's future research and development program.

Thank you, Mr. Chairman and members of the subcommittee, for this opportunity to present the views of the chemical industry.

I will be happy to attempt to answer any questions you may have regarding this view of the five-plant study at the appropriate time.

[The prepared statement of Mr. Thomas follows:]

CMA

CHEMICAL MANUFACTURERS ASSOCIATION

WRITTEN STATEMENT OF

J. DAVID THOMAS

OF

TENNESSEE EASTMAN COMPANY

ON BEHALF OF

CHEMICAL MANUFACTURERS ASSOCIATION

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH & ENVIRONMENT

COMMITTEE ON SCIENCE & TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

ON THE

CLEAN WATER ACT

June 10, 1982

My name is J. D. Thomas and I am a civil engineer with Tennessee Eastman Company, Division of Eastman Kodak Company. Today I am speaking on behalf of the Chemical Manufacturers Association (CMA), a nonprofit trade association whose company members represent more than 90 percent of the production capacity of basic industrial chemicals in this country. CMA members are directly and significantly affected by the requirements of the Clean Water Act (CWA) as implemented by the U.S. Environmental Protection Agency (EPA).

The installation of pollution control equipment by American industry has brought about major advances in cleaning up and protecting the nation's waters. Let me be specific as to the facts in the chemical industry. A joint EPA/CMA study was completed in the spring of this year. The study convincingly demonstrated that in-place biological treatment systems identified as best practicable technology (BPT) for the organic chemicals industry category provide a high level of removal of most organic priority pollutants.

In contrast, there are virtually no regulatory controls on other major sources of water pollution, namely non-point sources. CMA urges Congress to take the occasion of the reauthorization to evaluate carefully the progress that industry has made in the last ten years in water pollution control, and to assess to what extent additional controls on industrial discharges may be necessary and effective to achieve further improvements in water quality.

Current policies under the Act should be examined to ensure that future requirements are imposed only where necessary, beneficial and cost-effective. This will avoid devoting industrial capital to expensive but unnecessary treatment systems that do not provide commensurate water quality benefits. Where additional controls are needed, they should be developed in a way that directs the resources of EPA and industry at areas that really need attention. CMA urges the Congress to address these issues in connection with the reauthorization of the Act this year. The CMA positions set forth in this testimony are consistent with or directly supported by the report of the House oversight subcommittee in December 1980. 1/ That report discusses in detail significant problems with the Act's implementation and recommends amendments to the Act to address those problems.

I. THE PROMULGATION OF NATIONAL TECHNOLOGY-BASED EFFLUENT LIMITATIONS GUIDELINES

A central feature of the Act's control of the discharge of pollutants is the requirement that industrial

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1/ As a result of hearings during the 96th Congress, the House of Representatives Subcommittee on Oversight and Review of the Committee on Public Works and Transportation issued a report on implementation of the Clean Water Act ("the House Oversight Report"). Committee Print 96-71, 96th Cong., 2d Sess. (December 1980).

dischargers to the nation's waters meet a series of increasingly stringent levels of technology-based effluent limitations. This shift from exclusive reliance on water quality controls to technology-based requirements was a major change in prior law effected by the 1972 Amendments. Although this reliance on technology may have appeared sound in 1972, after a decade of experience the time has come to evaluate whether the universal application of technology-based effluent limitations actually results in better water quality or instead results in treatment for treatment's sake with no appreciable benefit to the quality of the nation's waters.

Treatment technologies already in place effectively control the discharge of pollutants -- even toxic pollutants -- to a degree greater than anticipated. Congress should refine the effluent limitations guidelines program to ensure that additional technology requirements are imposed only where they will help to achieve the water quality goals of the Act. CMA suggests that a refined effluent guidelines program will have three new elements: a limitation of the program to significant toxics problems; provision for modification of technology requirements where circumstances merit; and more realistic deadlines for promulgation and implementation of technology guidelines.

A. Reserve BAT Effluent Limitations Guidelines for Significant Toxics Problems and Significant Industry Subcategories

The task of developing best available technology (BAT) guidelines has proved to be very difficult. EPA has been unable to promulgate guidelines in a timely fashion, and current budget constraints will only hinder this task. It makes little sense to continue developing guidelines for a large number of industry subcategories. Instead, EPA should focus its efforts on developing guidelines where a significant toxics problem remains in a particular industry subcategory after the installation of best practicable technology (BPT), and where there are a sufficient number of plants in the subcategory to justify nationally-applicable requirements. This involves scrutiny of which pollutants are toxic and when a discharge causes a significant problem. Situations not covered by guidelines can be handled through BPJ permits.

1. Classifying Pollutants as Toxic

In the 1977 Amendments to the CWA, Congress defined toxic pollutants in Section 307(a) by reference to the list negotiated by NRDC and EPA in *NRDC* v. *Train*, 8 E.R.C. 2120 (D.D.C. 1976). [1] Congress provided that

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[1] *See* discussion of NRDC decree at pages 15-16 below.

EPA should revise that list from time to time "tak[ing] into account" certain specified criteria. Congress did not prescribe how the criteria should be weighted or, indeed, what it meant by taking the criteria "into account." As a result of the statute's vague criteria for classifying pollutants as toxic, EPA may in some cases classify pollutants on the basis of incomplete, inaccurate, or inadequately-reviewed scientific data.

To remedy this situation, EPA should be required to base its classification of a pollutant as toxic in water on substantial evidence that has been reviewed by an independent board of qualified individuals, that supports a finding that a significant and unreasonable risk of exposure exists. 1/ EPA should evaluate the severity of anticipated harm from a pollutant, the potential exposure of aquatic organisms, and the probability of harm occurring from exposure at various levels. The placement of pollutants on toxics list should be based on a risk assessment which

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1/ See discussion of peer review at pages 16-17 below. Moreover, the error in improperly designating a pollutant as toxic is compounded by virtue of the fact that the toxic pollutant list is referenced in other programs. See, for example, the Superfund legislation, Public Law 96-510, 42 U.S.C.A. § 9601(14)(A).

estimates the exposure of affected organisms to the pollutant of concern. [1]

EPA should also review the existing list of toxic pollutants and promulgate a new list based on the new criteria and risk assessments. Pollutants that do not satisfy the criteria should not remain on the toxics lists.

2. Defining a Significant Toxics Problem

EPA has not developed well-articulated priorities for regulating discharges. By attempting to address all levels rather than significant discharges of toxic pollutants, EPA simply dilutes its resources.

The Act should make clear that under certain circumstances EPA may exclude from Section 304(b) effluent limitations either a specific point source category or specific pollutants that are discharged by a category. Such circumstances should include, but not be limited to, situations where there are few sources within the category, where there are insufficient data to support a guideline, or where a pollutant is present in a discharge only in an insignificant amount. [1/] Similarly, public funds should not be spent in the development of guidelines applicable only to a few sources.

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[1] The supporting evidence should consist of an evaluation of the available scientific and statistical data, weighted as to relevancy, validation, and significance. The Agency should consider both data supporting the toxics classification and data that are not supportive.

3. Reserve Best Professional Judgment BAT Permit Limits for Significant Toxics Problems

Under the policy proposed above, BAT limitations for toxics would be set by nationally-applicable guidelines only when there is a significant toxics problem and there are sufficient plants in a subcategory to warrant the promulgation of national guidelines. If there is a significant toxics problem caused by a plant's discharge but no guidelines have been promulgated, then BAT limits should be imposed in a permit on a case-by-case basis. Such permit limits, like the nationally-applicable effluent limitations guidelines, should be based on an evaluation of the statutory factors, including costs and benefits, treatment alternatives, and inter-media effects.

[1/] In Section 101(a)(3) of the Act, Congress has set forth as a policy to prohibit the discharge of toxic pollutants in toxic amounts.

B. Modification of Effluent Limitations Where Circumstances Merit

Where economic or water quality circumstances merit, a discharger should qualify for alternative BAT effluent limitations. Section 301(g) of the CWA provides for a modification of the BAT limitations applicable to nonconventional pollutants where such modification will not interfere with the attainment or maintenance of water quality. Current law allows no modifications from BAT effluent limitations applicable to toxic pollutants. See CWA § 301(l).

Modifications to technology-based limitations beyond BPT should be authorized for all pollutants based on water quality considerations, by deleting 301(l) and modifying 301(g). If a state has adopted water quality standards that meet the requirements of the Act, and if there will be no interference with the attainment or maintenance of the water quality, it is appropriate to allow such a modification. In the absence of applicable standards, a modification should be allowed where the discharge will not present an unacceptable risk of harm in the receiving water based on its designated use. Otherwise, dischargers will be required to spend large sums of money for treatment that is unnecessary to protect the integrity of the nation's waters.

C. Extension for Compliance with BAT Limitations

Section 301 of the Act requires compliance by July 1, 1984, with BAT effluent limitations for toxic pollutants. This date has become unreasonable in light of the Agency's failure to promulgate effluent limitations guidelines for many industry subcategories and its inability to issue case-by-case permits to 69,000 discharges. 1/

Congress should extend the date for compliance with BAT limitations to a reasonable date based on a determination of (1) the time needed by EPA to complete its task and (2) the time needed by industry to comply with whatever limitations are imposed in permits based on published limitations guidelines, or, in the absence of regulations, the permit writer's best professional judgment. At a minimum, compliance with BAT limitations should be

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1/ The House Oversight Report notes (at p. 29) that current problems besetting the Agency "call into grave question whether the EPA is truly capable of putting into effect a genuinely workable, legally defensible and cost-effective regulatory scheme with which industry and local government can reasonably be expected to comply within the statutory deadlines." The House Oversight Report (at p. 62) recommends that this reality "be recognized sooner rather than later," and that the date for compliance with BAT treatment requirements be extended to compensate for EPA's delay in issuing treatment regulations.

extended until July 1, 1987. This coincides with the current BAT deadline for nonconventional pollutants. [1/]

II. LOCAL CONTROL OF THE PRETREATMENT PROGRAM

Section 307(b) of the Act authorizes EPA to establish pretreatment standards designed to prevent interference with the operation of POTWs or the passthrough of wastes that the POTW is not capable of treating. These standards are meant to implement the policy of Congress to avoid redundant treatment by industry and POTWs.

EPA has developed an elaborate and cumbersome pretreatment program. The most onerous aspect of this program involves the promulgation of national technology-based pretreatment standards applicable to dischargers of toxic and non-conventional pollutants. In the development of these standards, EPA has not given proper consideration to the amount of interference with the operation of POTWs, or the extent to which municipal

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[1/] Also, provision should be made for an extension of the BAT compliance date on a case-by-case if a discharger can show that, despite its good faith efforts, compliance with the limitations by the prescribed date is not feasible.

treatment systems effectively remove pollutants. [1]

The pretreatment program should be modified to focus more clearly on the special problems of interference and passthrough already identified in Section 307(b) of the Act, and to place principal responsibility for pretreatment requirements on the municipalities and states involved. Because the mix of wastes at individual POTWs will vary widely, each POTW will experience unique problems that are best addressed at the local level. Where an industrial discharger causes or contributes to a violation of a POTW's NPDES permit or a violation of EPA's sludge disposal guidelines under Section 405 of the Act, the municipal treatment authority (not EPA) should develop and enforce pretreatment limits on its users adequate to resolve the limits on its users adequate to resolve the problems. [1]

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[1] Although EPA's general pretreatment regulations refer to the granting of credits reflecting consistent removal of pollutants by POTWs, the barriers that the Agency has erected in its regulations make it unlikely that credits will in fact be given. Indeed, the House Oversight Report (at p. 42) quotes one municipal witness at the Subcommittee's hearings in June, 1980 as stating, "'The restrictions and difficulties involved in the granting of removal credits lead to the conclusion that the EPA was never serious about allowing removal credits to industry.'" Without credits, industrial dischargers will be required to install expensive treatment technology to meet pretreatment limits even though the POTW may remove all or most of certain pollutants in the dischargers' effluents.

III. THE ISSUANCE AND ENFORCEMENT OF NPDES PERMITS

Sections 301 and 402 of the CWA provide that pollutants may not be discharged to waters of the United States except in compliance with a permit issued by EPA or an authorized state. Pursuant to those provisions, NPDES permits were issued to most industrial direct dischargers prior to 1977. These permits have expired or will soon expire and need to be reissued. Based on experience gained from the first round of permit issuance and an examination of problems that are likely to arise in the future, certain changes in the permitting process appear to be in order.

A. Limit EPA's Veto of State Permits

EPA should not veto a permit proposed by an approved state on the basis of anything other than clear requirements of the Act or effluent guidelines regulations. By delegating the permit-issuing authority to the states, Congress intended to remove the federal government from that process to the extent possible. [1]

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[1] The House Oversight Report (at p. 62) states that steps should be taken immediately to allow municipal treatment authorities to implement their own pretreatment programs, which would include the establishment of local pretreatment standards. The Report unequivocally recommends that the use of national categorical pretreatment standards be abandoned. CMA supports the recommendations of this report as to the need to reform the pretreatment program.

Yet, in its NPDES regulations (40 C.F.R. § 123.75), EPA has asserted the right to object to state-proposed permits on a wide range of grounds, many of which involve merely a substitution of the Agency's judgment for that of the state. For example, 40 C.F.R. § 123.75(c)(6) allows EPA to object to any proposed effluent limitation which "in the judgment of the Regional Administrator" is improper, even in the absence of EPA effluent limitations guideline regulations. This means that the states never truly run their own programs. Every judgment of state officials is subject to review and reversal by EPA personnel.

EPA's failure to delegate meaningfully the NPDES permit program is criticized in the House Oversight Report (at p. 56), which urges EPA to "make every effort to ensure that these delegations of program authority are genuine." The law should be amended to make express the limited scope of EPA's review once an NPDES program has been delegated to a state.

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[1] Section 402(d) of the Act provides that EPA may veto a state-proposed permit only where the permit conditions are "outside the guidelines and requirements of [the] Act." Interpreting this section of the Act, courts have held that EPA cannot object to a state-proposed permit simply because it disagrees with the state. Nor can the Agency rely on informal guidance or memoranda as the basis for its objection. Ford Motor Co. v. EPA, 567 F.2d 661 (6th Cir. 1977).

B. Allow States to Enforce State-Issued Permits

When the Administrator learns of a violation of a state-issued NPDES permit, Section 309(a) of the CWA gives him the option either of bringing an enforcement action directly against the violator, or allowing the state to commence an enforcement action within 30 days after notification by EPA to the alleged violator and the state. EPA should not be allowed to bring an enforcement action for permit violations occurring in approved states. States that have assumed exclusive responsibility for implementation of NPDES programs should be given sole enforcement responsibility. Modifying the enforcement authority in this manner will also alleviate the "double jeopardy" that dischargers now face of prosecution by both EPA and the state. EPA would, however, retain oversight responsibility and the authority to withdraw its delegation where appropriate.

C. Extend the Life of NPDES Permit to Ten Years

The existing five-year maximum limit on the life of NPDES permits is unnecessarily short. Because it often takes one year for a final permit to be issued, and up to years to install treatment technology, the five-year limit leaves insufficient time to test the effectiveness of the treatment before the permit renewal application process begins. Further, where a permit has been issued on a case-by-case basis prior to the promulgation of guidelines, it should not be changed soon thereafter even to conform to subsequently issued guidelines. The permit program should be modified to provide for ten-year NPDES permits. [1/]

IV. THE NRDC CONSENT DECREE

In 1976, EPA entered into an unprecedented settlement agreement with the NRDC and several other environmental groups. That agreement, embodied in a court order, established a wide range of programs for the control of discharges of toxic pollutants not found in the Act.

Whatever purpose the consent decree may have had when adopted was superseded when Congress acted in 1977.

[1/] The House Oversight Report recognizes (at p. 62), extending the life of permits will provide "greater stability and certainty to the [NPDES] program" and more assurance to industry that it will not be required to replace or substantially modify pollution control equipment that has only recently been installed. Longer permit terms will also "allow a more effective utilization of the overburdened regulatory staffs of the EPA and the States." *Id*.

The 1977 Amendments to the Act provide a regulatory framework for the control of toxic pollutants and give EPA discretion to implement these provisions.

The NRDC consent decree has outlived its usefulness, and now serves principally to require certain actions that Congress in the statute committed to EPA discretion. The decree specifies criteria not found in the Act that EPA must follow in its implementation, and requires that EPA undertake programs not required by the statute. It forces EPA to prepare detailed justifications for many of its regulatory decisions, and the threat of a contempt suit gives the plaintiffs undue influence over EPA's regulatory actions.

Congress should make it unmistakably clear that the Clean Water Act directs EPA's program and that the NRDC consent decree should be vacated to remove the unjustified constraints on EPA's implementation of the CWA.

V. PEER REVIEW OF EPA'S SCIENTIFIC DETERMINATIONS

The Clean Water Act directs EPA to classify pollutants as toxics, to develop effluent standards for such toxics (Section 307), and to develop public water quality criteria (Section 304). In performing all of these tasks, the collection and careful evaluation of scientific information and data are critical. To ensure that the evaluation process is an objective one, it is essential that there be an independent review of the scientific data on which the scientific decisions are made. 1/

In performing its functions under Sections 304 and 307 of the Act, EPA should prepare and publish a critical evaluation of the relevancy, quality and accuracy of all scientific data, studies, and analyses on which it relies. These data, together with EPA's evaluation, should then be reviewed by an independent science advisory board. The board's mandate would be solely to review and analyze the data used as the basis for EPA's decisions and EPA's evaluation of the data. It would not review the regulatory decisions themselves, since such decisions would involve social and economic considerations outside the scope of the board's expertise. 2/

1/ An independent evaluation of scientific data is particularly necessary where, as in the case of much data in this area, the data are incomplete and subject to different interpretations. There is always the danger that such data will be used to support a preconceived notion, rather than being evaluated objectively.

2/ In its review of the data and EPA's analyses of the data, the board should point out those areas in which the data or analyses are inadequate or need to be revised. In proposing a new or revised decision, EPA should be required to justify any failure to follow or respond to the review board's recommendations.

CONCLUSION

This testimony summarizes a number of areas in which Congress should reassess and modify present policy under the Clean Water Act. CMA is prepared to work constructively with the Congress to address these issues in a sound, rational manner. We believe that the adoption of the foregoing proposals would make the Clean Water Act a more workable vehicle for protecting the environment and promoting the productivity of the nation.

Attachment

Research Needs and Opportunities in the Clean Water Act
as Recommended by the Chemical Manufacturers Association
to the Subcommittee on
Natural Resources, Agriculture Research, and Environment
Committee on Science and Technology
U. S. House of Representatives
June 10, 1982

Research Issues	Objective
1. Assess Current Control Technology for Removal of Priority Pollutants	To expand the cooperative EPA/CMA 5-Plant Study to establish the effectiveness of other treatment systems currently used by industry and municipalities.
2. Assess the Occurrence in Conventional, Nonconventional, and Priority Pollutants in the Nation's Surface Waters	To define remaining water quality problems in the nation's surface waters including the understanding of point and nonpoint sources.
3. In-plant Source Control Technology	To develop methods including process changes, recycle and reuse of wastewaters for the abatement of water pollution.
4. End of Pipe Control Technology	To develop improved technology for the treatment and removal of priority pollutants including reuse of treated wastewater.
5. Fate and Effect of Chemicals in Surface Waters	To develop methodologies and predictive models to better understand natural factors (e.g., assimilation, volatility, biotransformation, etc.) affecting aquatic systems.
6. Use of Biological Assessment in Surface Waters	To develop methods to define and understand the "quality" of the receiving waters including relationships between point source discharges and stream quality.

Mr. SCHEUER. Thank you very much.
Now, Dr. Lue-Hing.

STATEMENT OF CECIL LUE-HING, ASSOCIATION OF METROPOLITAN SEWERAGE AGENCIES

Mr. LUE-HING. Mr. Chairman and members of the subcommittee, my name is Cecil Lue-Hing and I am the director of research and development for the Metropolitan Sanitary District of Greater Chicago.

I am here today on behalf of the Association of Metropolitan Sewerage agencies [AMSA] to discuss the research, development, and monitoring needs which we believe are necessary for successful municipal implementation of the Clean Water Act, especially with regard to pretreatment programs and management of municipal waste treatment sludges.

In response to your request, I will read the topics which we believe need attention and summarize.

The USEPA research program, we believe, should be more directed to provide answers to help State and local agencies properly implement the act. In general, we feel that the Agency's programs should consist of two components: a short-term problem-solving component and a more long-term fundamental component to develop information to anticipate future problems and provide answers at the time those problems occur.

In the areas of local implementation, we believe that there is a tremendous need for better information in the area of analytical methodology for toxic organic pollutants.

We believe also that there is a need for additional information to develop or improve our level of confidence regarding the ability of in-place systems to remove these pollutants. We know that it occurs, but the reasons are not known. We need information to help us improve our level of confidence in these processes.

We believe there is a need for information to properly evaluate the environmental impact of toxic organic pollutants on lakes, streams, and the ocean.

We believe there is need for additional information to assist local agencies to properly dispose of sludges, particularly those associated with the industrial pretreatment system.

We believe also that there is a need for better risk assessment to make these assessments more balanced and realistic.

We believe there is a need for additional information on the fate of toxic organic materials in sludges so that we can properly dispose of these materials in the environment, whether it be on the land or in the ocean.

With respect to ocean disposal, we believe that research in ocean disposal of municipal sludges has been reduced, due to the past USEPA prohibition on ocean disposal. AMSA believes that there is a proper role for the ocean in the disposal of treated wastewaters and sludge. However, there is a need for reliable information to define this role. For example, information is required to determine what types of sludges can be discharged into the marine environment in a manner which is environmentally acceptable and cost effective. We urge Congress to direct the USEPA to conduct much needed research which would allow State and local agencies to properly utilize the ocean for wastewater and sludge management.

We wish to thank the Congress for their assistance in putting in place the ability for the EPA to allow the testing of large-scale systems based on our testimony of last year.

We believe that there is an additional need for information to allow State and local agencies to properly operate and effectively manage systems which are now in place.

We also believe that there is a need for better technology transfer on the part of the EPA. The program they had in place was severely curtailed because of reduced funding. The information transmitted by this route has been very helpful to local and State agencies.

In summary, the AMSA membership is quite prepared to accept the additional pollution control responsibilities being transferred to State and local agencies, since we believe that the site-specific nature of this problem makes this approach the proper one. However, we are distressed by the simultaneous reduction in funding for conducting the research necessary to assist State and local agencies to implement the objectives of the Clean Water Act. We believe that both State and local agencies will be better able to discharge these additional responsibilities if given the proper assistance of the Federal Government through the delivery of reliable scientific and engineering information for the design, implementation, and monitoring of municipal wastewater pollution control programs gained from properly instituted research programs conducted by or administered through the EPA.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Lue-Hing follows:]

ASSOCIATION OF METROPOLITAN SEWERAGE AGENCIES

Anchorage Water & Sewer Utilities, AK
Jefferson County Sewerage District, AL
City of Little Rock, AR
City of Phoenix, AZ
City of Tucson, AZ
Pima County Wastewater Management, AZ
Chino Basin Municipal Water District, CA
Orange County Sanitation Districts, CA
East Bay Municipal Utility District, CA
City of Los Angeles, CA
Los Angeles County Sanitation District, CA
Sacramento Regional County Sanitation District, CA
City of San Diego, CA
City of San Francisco, CA
City of San Jose, CA
Ventura Regional County Sanitation District, CA
Central Contra Costa Sanitary District, CA
City of Colorado Springs, CO
Metropolitan Denver Sewage Disposal District No. 1, CO
The Metropolitan District (Hartford County), CT
Miami-Dade Water and Sewer Authority, FL
Orange County Sewer and Water Department, FL
City of Tampa, FL
City of Atlanta, GA
City of Honolulu, HI
City of Boise, ID
MSD of Greater Chicago, IL
Sanitary District of Rockford, IL
City of Fort Wayne, IN
City of Wichita, KS
Louisville and Jefferson County MSD, KY
New Orleans Sewerage and Water Board, LA
Anne Arundel County, MD
City of Baltimore, MD
Washington Suburban Sanitary Commission, MD
Boston Metropolitan District Commission, MA
South Essex Sewerage District, MA
Upper Blackstone Water Pollution Abatement District, MA
Wayne County Public Works, MI
City of Kalamazoo, MI
Detroit Water and Sewerage Department, MI
Western Lake Superior Sanitary District, Duluth, MN
Metropolitan Waste Control Commission, St. Paul, MN
City of Kansas City, MO
Metropolitan St. Louis Sewer District, MO
City of Omaha, NE
Bergen County Utilities Authority, NJ
Middlesex County Utilities Authority, NJ
Passaic Valley Sewerage Commissioners, NJ
Ocean County Utilities Authority, NJ
City of Albuquerque, NM
Albany County Sewer District, NY
Buffalo Sewer Authority, NY
City of New York, NY
County of Monroe, NY
Nassau County Department of Public Works, NY
Onondaga County, NY
City of Greensboro, NC
City of Akron, OH
Greater Cincinnati MSD, OH
Cleveland Regional Sewer District, OH
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City of Dallas, TX
El Paso Water Utilities, TX
City of Fort Worth, TX
City of Houston, TX
City of San Antonio, TX
Gulf Coast Waste Disposal Authority, TX
Trinity River Authority, TX
Salt Lake City Public Utilities, UT
Hampton Roads Sanitation District, VA
Municipality of Metropolitan Seattle, WA
City of Tacoma, WA
City of Charleston, WV
Green Bay MSD, WI
Milwaukee County MSD, WI

STATEMENT BY

CECIL LUE-HING

DIRECTOR

RESEARCH AND DEVELOPMENT

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

CHICAGO, ILLINOIS

ON BEHALF OF THE

ASSOCIATION OF METROPOLITAN SEWERAGE AGENCIES

BEFORE

SUBCOMMITTEE ON NATURAL RESOURCES

AGRICULTURE RESEARCH AND ENVIRONMENT

U.S. HOUSE OF REPRESENTATIVES

WASHINGTON, D.C.

JUNE 10, 1982

Mr. Chairman and members of the subcommittee, my name is Cecil Lue-Hing and I am Director of Research and Development for The Metropolitan Sanitary District of Greater Chicago. I am here today on behalf of the Association of Metropolitan Sewerage Agencies (AMSA) to discuss the research, development and monitoring needs which we believe are necessary for successful municipal implementation of the Clean Water Act, especially with regard to pretreatment programs and management of municipal waste treatment sludges.

Through participation in AMSA, large metropolitan sewerage agencies have had the opportunity to share pertinent technical information on a wide range of issues critical to the ultimate success of the nation's clean water programs. This information has been shared not only through formal seminars and conferences, including the publication of proceedings for these meetings, but also informally through direct contact between one member agency and another. We believe that the AMSA membership has a firm grasp of the technical information which is needed today in order to more efficiently treat wastewater and manage the resulting sludge.

AMSA has continually urged the Congress to increase federal support for research and development activities so that scientific information on the generation, treatment and disposal of water pollutants will be gathered which would more effectively guide pollution control programs. This is especially important in view of the implementation of numerous water pollution control regulations which have resulted in continued growth in the construction activities and expenditure of funds for municipal water pollution control systems. My purpose today is to discuss areas of research which AMSA believes should be given serious consideration.

USEPA Research Program

AMSA strongly opposes recent reductions in funding for research in the municipal water pollution control area and urges the Congress and the Administration to continue to support much needed research to assist state and local agencies in developing, implementing and monitoring cost effective and environmentally acceptable pretreatment and sludge management programs.

The USEPA's research program should consist of two components; the first component being a short-term problem solving research program in support of the agency's regulatory function; and the second, a long-term fundamental research program designed to anticipate potential future environmental problems.

We believe that it is imperative for the USEPA to have adequate support and direction to fully participate in both components in order to develop and maintain the personnel and capability to provide the scientific and engineering support required by the agency's regulatory function.

With respect to long-term research, AMSA wishes to commend the Congress for approving and funding the development of six regional long-term Research Centers of Excellence located at institutions of higher learning. For example, on the campuses of the Illinois Institute of Technology and the University of Notre Dame is located the USEPA's Industrial Waste Elimination Research Center. This center is charged with the responsibility of conducting the fundamental research needed to understand how to eliminate industrial wastes at their sources rather than to treat them after they have been generated. AMSA urges the Congress and the Agency to continue to increase their support for these Research Centers of Excellence.

We believe that both short and long-term research resources currently available to USEPA are inadequate and in accordance with current budgetary projections are declining.

Local Implementation of Pretreatment Programs

The emphasis for implementation and management of wastewater pollution control programs is being shifted to the states and local agencies. While AMSA welcomes this emphasis on local control, we are distressed by the reduction in research and development support which is vital for effective implementation of these programs at the local level. We urge the Congress to increase support in the following critical areas:

1. Analytical methodology for toxic organic pollutants.

   While there have been significant advances in analytical methodologies for the toxic organic pollutants in recent years, there are still serious weaknesses in the precision and accuracy of the available analytical methods. Thus, the data for the toxic organic pollutants are limited as to their usefulness. More sensitive and accurate detection methods are needed in regard to levels, nature, and interaction of the toxic organic pollutants.

   Reliable analytical methods are a prerequisite for conducting detail surveys to determine removals of the toxic organic pollutants through municipal and industrial treatment systems, and for documenting ecological changes and water quality conditions resulting from their discharge.

   In addition, there is the need for development of less costly tests for the more common toxic pollutants so that long-term routine monitoring of wastewater discharges, which have been identified and are known or suspected to contain toxic pollutants, can be carried out.

2. Toxic organic pollutant removal through municipal and industrial wastewater treatment plants.

Additional information needs to be developed on the effectiveness of current municipal wastewater treatment practices in the removal of toxic organic pollutants, as evidenced by the results of recent studies of forty municipal wastewater treatment plants by the USEPA and five industrial biological treatment plants by the Chemical Manufacturers Association. Since there are inherent uncertainties in the analytical methods involved, this data base needs to be expanded in order to improve our level of confidence in the ability of municipal and industrial wastewater treatment systems to remove toxic organic pollutants. Research on levels of concentration, sources of pollutants, and the most effective techniques for their control are needed in order to allow local agencies to develop and implement adequate control strategies and to establish realistic control limits.

Similar information is required with regard to industrial pretreatment systems in order to assist state and local agencies to develop appropriate discharge limits for toxic organic pollutants.

3. Environmental impact of toxic organic pollutants on lakes, streams and oceans.

Information is needed to assist the states and local agencies in developing water quality and effluent discharge standards for the toxic pollutants. Such information needs to include the chemical species and organic composition, toxicity data, interactions with other compounds, and possible recycling of these compounds in the aquatic environment.

4. Disposal of sludges from industrial pretreatment systems.

The implementation of an industrial pretreatment program will result in the increased generation of industrial sludges. Research into methods of treatment and ultimate disposal of these sludges is needed to ensure that the disposal of these materials will not adversely affect the environment.

Methodology for Risk Assessments

The development of realistic environmental regulations require an assessment of relative risks. Regulations developed without adequate and realistic risk assessments will either be too restrictive and expensive or inadequate. Research is needed to develop information which will permit more realistic and balanced risk assessments with respect to discharges of toxic pollutants into the environment and the disposal of municipal and industrial sludges on the land and in the ocean.

Fate of Toxic Organics in Sludge

Basic research is needed on the fate of toxic organic constituents in municipal sludges in the various sludge management options available to municipal agencies. Such studies should include the extent to which synthetic organic compounds need to be stabilized prior to application to agricultural land, fate and interaction of sludge constituents discharged to the marine environment, stack emissions of organic compounds from municipal sludge incinerators, and uptake of organics by growing plants receiving municipal sludge.

Ocean Disposal

Research on ocean disposal of municipal sludges has been reduced due to the past USEPA prohibition on ocean disposal. AMSA believes that there is a proper role for the ocean in the disposal of treated wastewaters and sludge. However, there is a need for reliable information to define this role. For example, information is required to determine what types of sludges can be discharged into the marine environment in a manner which is environmentally acceptable and cost effective. We urge the Congress to direct the USEPA to conduct much needed research which would allow state and local agencies to properly utilize the ocean for wastewater and sludge management.

Full-Scale Demonstration Projects

Congress is to be commended for their support of large-scale testing of new municipal wastewater treatment technology under the USEPA's Innovative and Alternative Technology program, and AMSA recommends the continued support of the Congress for this program. We believe that this investment, in the long term, will result in more effective pollution control at a lower cost.

I have presented a more detailed discussion of this topic before the Subcommittee on Investigations and Oversight Committee on Public Works and Transportation, U.S. House of Representatives, on July 21, 1981. This testimony is attached for this committee's information.

Municipal Treatment Plant Operational Research

With the lower levels of funding anticipated in the future, the expansion of existing plants and new plant construction will be severely curtailed. Therefore, it is important to maximize the performance of in-place municipal treatment plants.

We, therefore, urge the Congress to direct the USEPA to increase their research efforts in the development of information to assist local agencies in implementing the operational changes required to increase the efficiency and reliability of existing municipal wastewater treatment plants.

Technology Transfer

The conductance of research is meaningless if the results of the research are not properly communicated to the wastewater treatment profession in a manner which is useable. AMSA believes that the Technology Transfer program which was implemented by the USEPA played an important part in fulfilling this need. AMSA urges the Congress to provide the funding for continuance of the Technology Transfer program.

Summary

In summary, the AMSA membership is quite prepared to accept the additional pollution control responsibilities being transferred to state and local agencies, since we believe that the site specific nature of this problem makes this approach the proper one. However, we are distressed by the simultaneous reduction in funding for conducting the research necessary to assist state and local agencies to implement the objectives of the Clean Water Act. We believe that both state and local agencies will be better able to discharge these additional responsibilities if given the proper assistance of the federal government through the delivery of reliable scientific and engineering information for the design, implementation and monitoring of municipal wastewater pollution control programs gained from properly instituted research programs conducted by or administered through the USEPA.

ASSOCIATION OF METROPOLITAN SEWERAGE AGENCIES
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Louisville and Jefferson County
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Anne Arundel County, MD
City of Baltimore, MD
Washington Suburban Sanitary
Commission, MD
Metropolitan District Commission
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Abatement District, MA
Wayne County Public Works, MI
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Metropolitan Waste Control
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City of Kansas City, MO
Metropolitan St. Louis Sewer
District, MO
City of Omaha, NE
Bergen County Utilities Authority, NJ
ssex County Sewerage Authority, NJ
Passaic Valley Sewerage
Commissioners, NJ
Ocean County Utilities Authority, NJ
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Buffalo Sewer Authority, NY
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Green Bay Metropolitan Sanitary
District, WI
Metropolitan Sewerage District of the
County of Milwaukee, WI

STATEMENT BY

CECIL LUE-HING

DIRECTOR

RESEARCH AND DEVELOPMENT

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

CHICAGO, ILLINOIS

ON BEHALF OF THE

ASSOCIATION OF METROPOLITAN SEWERAGE AGENCIES

BEFORE

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

U.S. HOUSE OF REPRESENTATIVES

WASHINGTON, D.C.

JULY 21, 1981

Mr. Chairman, my name is Cecil Lue-Hing, and I am the Director of Research and Development for the Metropolitan Sanitary District of Greater Chicago. I am here today on behalf of the Association of Metropolitan Sewerage Agencies to discuss ways to improve and expand research and development efforts as they relate to the design and construction of wastewater treatment processes and systems. We think this can be done better, with savings in time and money for the construction grants program.

Through participation in AMSA, large metropolitan sewerage agencies have had the opportunity to share pertinent technical information on a wide-range of issues critical to the ultimate success of the program. This information has been shared not only through formal seminars and conferences, including the publication of proceedings for these meetings, but also informally through direct contact between one member agency and another. Moreover, to improve information transfer and thus ensure that the membership is aware of the extensive research and development work conducted by individual member agencies, AMSA plans shortly to establish an R&D Clearinghouse.

In addition to these efforts, AMSA has continually urged the Congress to increase federal support for wastewater research and development activities so that scientific information on the generation and disposal of water pollutants may more effectively guide pollutant control programs. This is especially important in view of recent and pending implementation of numerous water pollution control regulations, which has resulted in continued growth in the construction activities and expenditure of funds for municipal water pollution control systems. Some of this growth is manifested in the increasing number of new and unproven water pollution control processes and systems being offered to the municipal sector.

The mechanisms available to assist municipalities in deciding which processes or systems to utilize in either expanding existing plants or designing and constructing new facilities are not always satisfactory because they do not properly address urgent, current problems. The mechanisms include the following:

1. A reliance upon manufacturers' performance claims for processes and equipment;
2. Experience gained from other installations, if such exists;
3. The results of limited pilot plant testing; and
4. Suggestions and/or recommendations from regulatory agencies, in some instances.

Experience has shown that there are serious deficiencies in this system associated with the following:

1. Manufacturers' claims are not always valid and are usually overexpressed.
2. Frequently there exists only limited municipal field experience with new processes and systems.
3. Operational results from small-scale pilot plant evaluations are sometimes inadequate; and cost anlayses for construction and operation of these new systems are not reliable, and usually are understated.

Thus, in order to achieve treatment objectives at reasonable costs, these deficiencies need to be eliminated or at least minimized. It is the intent of this presentation to offer some suggestions relative to the role which AMSA membership agencies can play in an attempt to correct these deficiencies.

Deficiencies of Current System in Implementing New Technologies

There are many reasons for these deficiencies, some of which are briefly described below:

1. Incomplete developmental work even in the presence of sound or acceptable theory or process concepts.

   This situation may result from:

   a. The eagerness of the developer or inventor to get the product to market in the case of new equipment, or install a composite system in the case of a new process.

   b. The lack of money and other resources for comprehensive testing and evaluation.

2. The inability of small municipalities to field test new equipment and/or technology. This situation may be aggravated by:

   a. Pressure of deadlines from regulatory agencies.

   b. Pressure from regulatory agencies to utilize new processes or technologies which have been subjected to only limited testing, and under carefully controlled non-field or laboratory conditions.

   c. Lack of in-house resources to verify processes or systems integrity.

3. Lack of large-scale pilot plant or demonstration plant operational data to confirm original concept or theory. This may be the case because:

   a. Scale-up factors are not well defined for new technologies.

   b. Reliability of processes cannot be tested on a small scale.

   c. Operating costs cannot be properly assessed on small systems.

4. Lack of information on how a given technology may perform under different situations of field or regional conditions. This may be the case because:

   a. Wastewater and sludge at different locations have different characteristics.

   b. Development testing may have been done under idealized conditions.

c. Published information detailing the performance capability of new processes or technology is not available.

Since municipal agencies cannot request funding from their constituents twice for the same public works projects, there is naturally much reluctance by local agencies to risk the consequences of purchasing or installing expensive new technologies which do not perform in accordance with expectations. Thus, the reluctance to implement at the local user level restricts the progress of new technology utilization, sometimes at long-term financial sacrifice. This reluctance does not represent the inability of local agencies to make important decisions at the local level, but rather is an expression of their determination to ensure that local funds are expended where there exists the highest probability for acquiring systems which work effectively and are best suited to their needs.

Role of Large Municipalities/AMSA Membership in Evaluating New Technology for Acceptance

The AMSA membership provides a unique setting for conducting applied testing of large-scale pilot systems. This procedure does not in any way present a conflict with long-term anticipatory university-oriented research. Indeed, the procedure represents a necessary step or the bridge between anticipatory research and full-scale implementation. In any event, the resources of AMSA membership are not available within the university setting.

AMSA membership certainly has abundant available resources of physical facilities, technical expertise, and materiel to conduct these necessary extensive and large-scale scientific and engineering evaluations of the effectiveness, appropriateness, and predictable costs of the technologies requiring testing. AMSA membership certainly possesses the ability to bridge the gap between the so-called bench-scale technologies through the use of large-scale pilot systems. This procedure will ensure a high degree of confidence and verification of new system performance credibility under the impact of actual field conditions, as opposed to the carefully controlled laboratory conditions associated with bench-scale testing.

AMSA believes that,since the Construction Grants Program represents public funds, all levels of government associated with this program have the obligation to expend these funds prudently and in such a manner that our constituents derive the greatest benefit at the lowest possible cost.

Specific AMSA Contributions

AMSA envisions a cooperative venture with the federal government as follows:

1. Identification and development of a roster of membership facilities which may be made available for use as large-scale pilot systems for prescribed periods.

2. These facilities would have available, also, all or most of the technical expertise relating to process evaluation, operations, monitoring, R&D capability, and overall systems evaluation.

These resources would permit large-scale field evaluations at the lowest possible cost since the construction of new facilities to test a particular process or technology would not be necessary. Construction expenditure, if any, would be necessary only in cases where the new process or technology may require minor modifications of existing AMSA facilities. Further, since AMSA membership owns and operates a wide variety of treatment systems in all geographic regions, this limited expenditure for construction may be further reduced.

Specific Federal Contributions

AMSA envisions that the Federal contribution for such a program would include:

1. The actual cost of salaries of personnel directly engaged in the field evaluation project;
2. The cost of materials, such as chemicals, etc;
3. The cost of Specialized exotic monitoring equipment not normally utilized by AMSA membership or which may not be available at the site selected; and
4. The cost of any physical revision which may be necessary.

Quality Control

In the interest of quality control, the work being conducted at an AMSA facility may be subjected to constant scrutiny by a review group selected because of their demonstrated expertise in scientific or technical disciplines relevant to the project.

AMSA believes that such a cooperative venture would be most successful since the evaluation and demonstration of a system's effectiveness would receive the direct input of individuals who may ultimately own and operate such systems.

The benefits clearly would be the availability of large-scale operational data, more reliable cost projections, a higher level of confidence in the performance capability of new technologies, and a reduction in the long-term cost of pollution control.

This concludes my prepared testimony. I want to thank the Committee for the opportunity to testify today, and I would be happy to respond to any questions at this time.

Mr. **Scheuer**. Thank you very much, Dr. Lue-Hing.

Now, we will hear from Italo Carcich who is representing the Association of State and Interstate Water Pollution Control Administrators.

STATEMENT OF ITALO CARCICH, ASSOCIATION OF STATE AND INTERSTATE WATER POLLUTION CONTROL ADMINISTRATORS, ACCOMPANIED BY ROBBI J. SAVAGE, EXECUTIVE DIRECTOR, ASSOCIATION OF STATE AND INTERSTATE WATER POLLUTION CONTROL ADMINISTRATORS

Mr. **Carcich**. Mr. Chairman and members of the committee, my name is Italo Carcich. I am here today to represent the Association of State and Interstate Water Pollution Control Administrators [ASIWPCA], a State association that represents all 50 States, several territories, and 6 interstate commissions.

Mr. Chairman, I am the director of Bureau Water Research within the Division of Water in the New York State Department of Environmental Conservation. I have been responsible for the past 2 years for research, both in urban and nonurban pollution, as well as agricultural sources of pollution. I have also been asked to implement some of the clean lakes programs, specifically, the diagnostic feasibility phase one studies. As well, I am acting as laboratory coordinator for analytical needs for the entire department.

Because the committee has already up to this point discussed some program issues outside my particular area of expertise, I have asked Robbi Savage, executive director or ASIWPCA, to join me at the table this morning.

Needless to say, I have flown here this morning from Albany where I left a beautiful sunny day and came to Washington on a rainy morning. The reason I came was to emphasize a need for a very strong and effective R&D effort.

In my testimony, I have presented a number of major points that need to be addressed, but I feel that a balanced partnership must be achieved between the Federal and State government in order to achieve a program that will meet both the qualitative and quantitative needs and goals of the Clean Water Act.

Research and development programs in the past dealt with real-world technology often identified in the regional regulatory efforts. Such efforts should be continued in the future.

At the same time, I do want to emphasize a program that has emerged in the last couple of years. That is the toxic substances program. Aquatic systems are being contaminated by toxic substances. However, any comments that are made here in this forum take the risk of oversimplifying a very serious situation. Over the past 15 years, the number of water quality parameters targeted for management has grown from the conventional to include several heavy metals and more than 100 organic priority pollutants.

The presence of toxic substances in sludges and dredged material is complicated and already a difficult problem. A small percentage of sludges are being spread on land throughout the country, without adequate information as to the effect of this practice. The bulk of the sludge and dredged spoils are still disposed via landfill and ocean disposal. Some are disposed also by means of incineration.

Every attempt should be made to intensify both basic and applied research on sludge management.

In New York State and other States, nonpoint sources of pollution are again a very critical area. The effectiveness of methods of controlling a number of agricultural nonpoint sources of nutrients and sediments has been evaluated or is being evaluated. However, the value of no-till farming, for instance, in a dairy-farm oriented agriculture, such as New York State, is not well understood. The crops and crop-land managements supporting dairy farming are considerably different from cash-crop production in the midwest.

The increasing promotion being given to no-till farming warranted research efforts to determine the suitability of a water quality best management practice.

For the sake of time, I will conclude the statement. Thank you, Mr. Chairman.

[The prepared statement of Mr. Carcich follows:]

TESTIMONY OF
ITALO G. CARCICH,
DIRECTOR OF BUREAU OF WATER RESEARCH,
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
IN BEHALF OF ASIWPCA

BEFORE THE
UNITED STATES HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH AND ENVIRONMENT

June 10, 1982

Chairman Scheuer, Members of the Subcommittee, I am Italo Carcich, Director of the Bureau of Water Research, New York State Department of Environmental Conservation. I am here representing members of the Association of State and Interstate Water Pollution Control Administrators. It is up to these Administrators to effectively implement the 1972 Clean Water Act and all of its amendments--a task that has become increasingly difficult to accomplish due to diminished funding sources and increasing economic pressures. While tremendous progress has been made in the past in controlling water pollution, much still needs to be accomplished. A few persistent water quality problems still exist; others, such as contamination of surface waters and groundwater with toxic substances, have just recently surfaced.

My presentation today focuses on the research and development as well as the monitoring needs for the successful implementation of the Clean Water Act in controlling water pollution. Strengthening the research programs will directly contribute to a more active and cost effective implementation of the Clean Water Act. At the same time, we recognize a need to reduce or possibly eliminate research that is not cost effective.

In a recent statement before of the HUD--Independent Agency Subcommittee of the House Committee on Appropriations, Mr. Leo Weaver, Executive Director and Chief Engineer of the Ohio River Valley Water Sanitation Commission (ORSANCO) stated, "Research and development and Section 106 funds are essential if the state and federal governments are ever to achieve the partnership in controlling water pollution that was envisioned in the 1972 Clean Water Act." It is for this reason that basic research should be funded and carried out at the federal level and applied research be conducted by the environmental expertise located within state and interstate agencies. We must, therefore, establish this carefully balanced partnership, as described by Mr. Weaver, to support our efforts in controlling water pollution--a partnership that compliments various state/interstate and federal research and development efforts.

The continuation of the research and development program is essential to meet qualitative and quantitative goals and objectives of the Clean Water Act. Listed below are some of the most important reasons to support this program:

(1) the need to control non-point source of pollution by the application of best management practices, many of which have not been adequately defined or demonstrated;

(2) the need for improved, demonstrated processes for the removal of toxic pollutants from industrial discharges by pretreatment or treatment processes;

(3) the need for simple and less expensive waste treatment alternatives for smaller communities;

(4) the need to quantify the cause-effect relationships between discharges and receiving stream quality through improved monitoring techniques, analytic techniques, and modeling;

(5) the need for establishing relationships between concentrations of toxic and hazardous pollutants to human health;

(6) the need to investigate the fate and effect of toxic pollutants on groundwaters including the development of remedial measures to restore groundwater quality;

(7) the need to perform technical evaluation of dredging operations and dredging systems as a means of reclaiming aquatic resources contaminated by toxic substances;

(8) the need to evaluate various indicators and screening tests for environmental contamination;

(9) the need to characterize chlorinated organics formed from chlorination of wastewater effluents;

(10) the need to develop methods to assay the toxicity of complex mixtures such as PCB's, dioxin, and dibenzofuran;

(11) the need to improve understanding of the responses of the aquatic environment to acidification and cost effective remedial measures;

(12) the need to research methods for controlling nuisance aquatic vegetation, which is impairing an ever-increasing number of public-accessible lakes.

Research and development programs in the past have dealt with real world technology needs, often identified in the regional regulatory effort, and such efforts should be continued in the future.

The USEPA program should be reordered to focus available, yet limited, resources on relevant national program concerns. The regionalization of an applied research and development program, which can best be formulated by inputs from individual states, will not only benefit the regulators but also bring economic benefits to the entire water pollution control industry. As has been the case in the past, the research and development program, administered to meet the diversified needs, has always provided economic incentives for the development of new technology and the creation of new water pollution control industry. While it is our goal to improve and restore water quality standards, a research and development program does not always provide the ultimate solutions to all of our water pollution problems, but rather a means to significantly improve various problem areas.

Briefly, I would like to discuss three areas: toxics, sludges and non-point sources, which should be given high priority in the research and development program. With regard to contamination of aquatic systems by toxic organics, any comments made in the forum provided risks oversimplifying a very complex issue. Research problems range in complication from the very basic and soluable to the esoteric. We are continually improving methods for defining environmental levels of toxics while the determination of human health and ecological significance to those levels still remains a knotty problem. Over the past 15 years, the number of water quality parameters targeted for management has grown from the conventional to include several heavy metals and, at present, more than 100 organic priority pollutants.

Assuming that water quality management strategies will continue, for the short term, to be managed on a substance by substance basis and that risks associated with environmental exposure will be conservatively incorporated with regulations, immediate research needs to improve the definition of environmental exposure. Accounting for variability in environmental data sets for toxic organics is generally more difficult than for conventional pollutant data. Definition of environmental levels of toxic organics in aquatic systems has largely resulted from sampling methods used for conventional pollutants. Sampling and analytical errors probably account for much of the variability. Sampling biases in investigations of spatially and temporally variable systems are compounded by analytical costs which typically preclude the sampling intensity afforded by investigations of conventional pollutants. Sampling methods are needed to better integrate spatially and temporally existing conditions and reduce the effort required for analysis of toxic organics. Specific physical and chemical properties of the species or class of compounds might be exploited to obtain a better sample. Identification of factors controlling variability in data sets and normalization of toxics data to those factors are approaches that have proven to be valuable and warrant continued research support.

The presence of toxic substances in sludges and dredged material has complicated an already difficult problem. Thousands of tons of domestic and industrial sludges, as well as dredged spoils, are generated daily without environmentally safe and economically feasible disposal systems. A small percentage of these sludges are spread on land throughout the country without adequate information on the effects of this practice on the terrestrial ecosystem. The bulk of the sludge and dredged spoils are still disposed via landfills, ocean dumping and incineration.

Every attempt should be made to intensify both basic and applied research on the sludge management. This is essential if we are to minimize the adverse impact of current sludge management practices on the terrestrial and aquatic ecosystems.

In New York State and other states, non-point sources of plant nutrients and sediments to surface waters are dominated by agricultural activities. The effectiveness of methods of controlling a number of agricultural, non-point sources of nutrients and sediment has, or is being evaluated. In evaluating conservation practices as water quality management practices, it is found that the objectives of the agricultural support agencies and the water quality management agencies are aligned. That is, practices which conserve plant nutrients and soil on a farm usually serve to improve water quality. However, with respect to the increasing promotion of no-till farming, it is not clear whether these interests can continue to support each other. The water quality benefits of no-till farming relate to soil conservation. In the midwest no-till farming has been very successful in reducing sedimentation in rivers and lakes. The trade-offs in increased herbicide and pesticide use that accompanies no-till farming are understood. However, the value of no-till farming in contrast to other tillage systems, as a water quality management practice in dairy farm-dominated agriculture is not well understood. The crops and cropland management supporting dairy farming are considerably different from cash-crop production in the midwest, where no-till farming received its acclaim.

While no-till farming could be expected to reduce soil losses from the silage corn fields which largely support dairying, the effects of manure-spreading on these fields are uncertain. Presently, manure is applied as a fertilizer to those fields at a rate determined by its nitrogen value, which typically results in over-fertilization by phosphorus. Manure is usually spread daily while livestock are confined. There is generally little manure storage capability throughout the state. At least once each year, the manure is incorporated with the soil by plowing. The immediate water quality benefits projected for no-till farming in the short-term might be defeated by an increased loss of nutrients to surface water and to the atmosphere due to the long-term accumulation of animal wastes on the surface of these no-till farming fields. The increasing promotion being given no-till farming warrants a research effort to determine its suitability as a water quality Best Management Practice (BMP).

Even though the effectiveness of controlling a number of point and non-point sources of pollution has been extensively documented, much remains to be done in an effort to find suitable implementation procedures that are economically feasible.

It is an historical fact that during times of economic "belt-tightening", research and development programs often become the most likely candidates for the budget axe. For the short term, this may appear to be a most attractive and feasible maneuver. However, a closer look will reveal that these small economies accomplished today will, in the long run, provide large-scale headaches for future preservation and management of our environmental assets.

I thank you for the opportunity to testify before your subcommittee today.

Mr. SCHEUER. Well, thank you very much, for your testimony, Mr. Carcich. Your testimony was very helpful, and I feel very happy that you are carrying on your significant responsibilities in New York State. I am proud of your testimony and of your leadership.

Frankly, I would have a little more confidence in turning over these vast water pollution control responsibilities—research and operations—to cities and States if the kind of knowledge, professionalism, and leadership that you represent, were typical of all the States. Unfortunately, however, in our experience we have found that there are but a few States that have outstandingly able professionals, researchers, and administrators in these important regulatory agencies, but all too many of them that neither can command the expertise or the will to do the kind of job that you are doing.

Therefore, I thank you for your testimony.

Now, our distinguished colleague, Congressman Carney, has been singly honored and reflects honor on our subcommittee by having been designated by President Reagan to represent the Congress as a special advisor to the U.S. delegation to the current Special Session of the General Assembly on Disarmament. In contributing to the progress on disarmament, I feel he is contributing to the mission of this committee in lessening national and global degradation of our environment—our water and our air environment.

Therefore, in order to help Congressman Carney meet this great challenge that the President has honored us all with, I am going to recognize him so that after his questioning, he can be on his way representing all of us, I am sure in this room, by his diligent efforts at the East 42d Street Headquarters of the United Nations.

Mr. CARNEY. Thank you very much, Mr. Chairman. In essence, what the chairman said is that he is allowing me to go first because I have to catch a plane, but he said it a heck of a lot more eloquently than I would, and I appreciate those kind words.

I would say by briefly looking over the testimony of everyone on this panel, one, that the testimony is of outstanding quality, and it is going to bring to us a better understanding of R&D needs and help us through our task here.

However, I would like to put a hypothetical scenario up before the panel and ask a question after I set that scenario. That is: that given that there are 30 plus States whose State legislatures have passed resolutions calling for a Constitutional amendment for the Federal Government to have a balanced budget. There is a movement in the Nation. In fact, our President speaks about the balanced-budget requirement as a constitutional amendment.

If that were to happen, and we do not have the luxury—I shouldn't use the term "luxury," but many people think that it is a luxury to go into a deficit-type of funding situation for our Federal budget—and we have to meet those balanced-budget criteria in a timeframe that would initiate drastic cuts in areas, what do you distinguished members of this panel see the States' role in the area of clean-water and waste water management—the whole overview in clean water and the techniques necessary to establish clean water and maintain clean water? Do any of you want to answer that question? I guess what I am saying is are the States continuing the programs to find funding mechanisms to do that?

Dr. LUE-HING. I will take a crack at it, Mr. Carney. I don't think that I can speak for the States, but I think that the message we are trying to present here is that the States--I know AMSA membership is quite prepared to accept the additional responsibility, but there are some answers that we need to do that job properly.

Let me give an example at the local level. As head of the R&D group for the Chicago district—a single district—I have a staff of almost 300 people and a budget of almost $8.5 million. I tell my board at budget time that if I don't save you $10 for every dollar you spend, I am expensive.

I have been there for 12 years, and we have contributed significantly to the efficiency not only of the Chicago system but of sister systems throughout the country through our own local effort.

I think that, while States generally may not be reluctant to accept additional responsibilities, what we are saying is we need the assistance of the Federal agency such that we can go home and feel assured that the answers that we are looking for today and 10 years from now will be there. Given that information and the additional support from the Federal Government, we can get the job done properly.

All we are saying is that, while the responsibilities may be burdensome—I cannot say how the States will fund these additional programs—where the States can pick up the local responsibility, we can get the job done if we get the continued and increased support of the Federal Government.

Mr. CARNEY. Would it be fair to say then, sir, that you feel that the research and development aspect of this business is something that the States would prefer to be the priority of the Federal Government? The implementation of water pollution control activities in that would be something, if given the proper data base, the States could more readily take over. Would that be an assumption?

Mr. LUE-HING. Generally, yes. Given the information that is needed, the States can get the job done much more efficiently in the long run at a much lower cost because if we put in a place a program that requires too many mid-course corrections because of a lack of data, we may have to abandon some very expensive programs and start all over again.

In essence, we do have the information available today to make a very good start. What we need is improvement on that information to continue to implement and to improve our implementation and to increase our cost effectiveness with time.

Mr. CARNEY. Thank you. Would anybody else like to comment. Doctor?

Mr. SCHEUER. May I add just a word to that?

Mr. CARNEY. Surely, Mr. Chairman.

Mr. SCHEUER. You need improved data, an improved knowledge base. As the rest of you answer that, tell us where the R&D should be carried out and where the funding should be coming from. Should the Federal Government actually do the research or should they fund States to do it or should industry do the research? Do they have the capability to perform that most cost-effectively, and, if so, are they capable of funding it themselves, or do they need help from some level of Government, and, if so, from which level?

Mr. **Carney**. I think that the chairman stated it better than I did.

Mr. **Scheuer**. Well, we stated it very well together.

Dr. **Gloyna**. The important point is that research and development should have a very high priority. Beyond that, the funding will be carried on in the various areas that have the competence. Many of the States in their programs, including their universities and their industrial establishments, could make a very vital contribution. There is a pool of research capability in the Federal establishment, in the universities, and in industry—all of them people capable of carrying on and conducting important work that must be done.

Mr. **Carney**. Doctor, I am getting close to that time when I have to leave. I am going to ask if I can go off that topic for a second. You stated in your statement before that it would be foolish for anyone to give up one type of method that we are now utilizing in getting rid of sewerage sludge, ocean dumping, landfill, and that type of thing.

I would like to ask you—this is a very, very important topic not only to me but certainly to the chairman of this subcommittee—a couple of questions along that line. One, do you feel that we have narrowed down the ways and means in which we could remove seweage sludge say to ocean dumping, landfill, and incineration? Two, how far away would you project that we really can make the types of decisions that this Congress is going to have to make as to the methods that we utilize in disposing of sludge?

Mr. **Gloyna**. I will try to answer there questions. We believe that landfill and ocean disposal are viable alternatives. They are applicable for specific areas, and we have enough knowledge to be able to undertake these projects at this time. However, each concentration and disposal methodology must be evaluated. There are a number of questions that must be fully studied and fully understood before these viable alternatives can be made universally applicable.

Mr. **Carney**. What about incineration?

Mr. **Gloyna**. That is also a possible alternative—an additional means of concentration and preparinq the material for ultimate disposal.

Mr. **Carney**. I think that what you are saying then is that the Congress at this time would perhaps be premature to eliminate any one of those options even in specific cases.

Mr. **Gloyna**. Yes.

Mr. **Carney**. Because there is not enough information available?

Mr. **Gloyna**. Well, we certainly would not want to eliminate one completely. We have the capability of using these modes of disposal effectively for specific areas and specific locations.

Mr. **Carney**. And in determining that, you have to analyze all the available methods, and that is what we should be doing at this particular time.

Mr. **Gloyna**. That is correct.

Mr. **Carney**. I thank you very much, Doctor, and I thank the chairman for his courtesies, and I thank the members of the panel.

That was very informative. I will submit written questions if I may, Mr. Chairman.

Mr. SCHEUER. Absolutely.

Mr. CARNEY. Thank you, Mr. Chairman.

Mr. SCHEUER. We welcome your participation this morning. Do any of you wish to answer the question that Congressman Carney and I sort of jointly propounded before?

Mr. CARCICH. Yes, I do. What I would like to briefly state is that as far as the R&D program, EPA should have an oversight role and have industry also invest funds in the R&D program. For instance, if you look at the past 20 years, the United States water pollution control industry has been the leader in the world mostly because of a strong R&D effort that was started back in the 1960's.

New York State as well as other States need an R&D program that is tailored made for their own specific State individual needs. This is the reason that a combined effort—a unified effort—should be made to sponsor an effective R&D program that is geared toward State's needs that is funded to some degrees by industry, but where EPA provides the oversight capability.

New York State, as well as the association, has made tremendous efforts in technology transfer that could possibly eliminate some additional needs for R&D programs. This is where I think that we can make some additional inroads toward improving the R&D program.

Mr. SCHEUER. Mr. Carcich?

Mr. CARCICH. Yes.

Mr. SCHEUER. In just following up on your question and referring to Assistant Administrator Hernandez's statement that the States did have sufficient resources and information to assume greater responsibilities for protecting water quality, would you tell us whether you think the States have sufficient resources and sufficient information and sufficient expertise—sufficient will—to undertake this tremendous responsibility that the administration seems determined to transfer to cities and States with the attendant cut in the resources available of about 40 percent in R&D and about 20 percent in section 106? If any of the rest of you wish to respond to that same question, we will do that right after we hear from Mr. Carcich.

Mr. CARCICH. Let me ask, first, Robbi to really answer on behalf of the association, and then I will give you New York State's point of view on that point.

Mr. SCHEUER. Good.

Ms. SAVAGE. In explaining the amount of money that is going to the States, Dr. Hernandez this morning referred to not only 106 but also section 205(g) and section 205(j). Dr. Hernandez indicated that there would be additional moneys going to the States that were not available before.

I suspect that literally on paper that could be a correct statement. However, when you look at the justification for reducing the 106 program which is that 205(j) moneys will be available in the amount of about $24 million, that is not new money. That is money that is taken out of construction of sewerage treatment facilities. Therefore, it will be used for other purposes, but it is not new money going to the States to do their work. That is assuming that we ever get an appropriation, and I hope that we do, for the construction grants program under the emergency supplemental. If we do not, as Mr. Eidsness indicated, there will be a very, very serious problem for the States to manage their programs at all, R&D aside or included.

By way of whether the States have the commitment, yes, they do. Mr. Carcich indicated that we have the technology transfer program within our association so the States like New York can help some of the other States that do not have the sophisticated programs. However, we need to look at what the State legislators are doing right now. For example, our president in the State of Oregon has to reduce in forces up to 40 percent before the Federal Government makes any reductions at all. This is State funding for the programs.

Therefore, it is very complex, and it is not just the Federal program. It is across-the-board, State-to-State, and how it implements through their State legislatures.

Mr. SCHEUER. I would also add that Deputy Administrator Hernandez states that there is $23 or $24 million that can be taken out of the construction program. Why is this money being taken out? Congress must have had some thoughts as to what would be an adequate level of funding for construction. The fact that there is $24 million available to be taken out of that and used for other purposes suggests either that we appropriated too much in the first place or we appropriated a reasonable level for construction programs but that those moneys are not being used for that purpose.

Do you have any idea as to which of those alternatives it might be?

Ms. SAVAGE. As I understand the rationale for the 205(j), it was to beef up the planning and monitoring and water quality standards under the act. Since 208 was not funded, they used this mechanism to carry on the work of nonpoint source water quality standards which they have to implement within 3 years.

Dr. Hernandez also indicated this morning that the States now also have an increase in construction grants money of 4 percent of the authorized amount. It is an increase in percentage, but 2 percent of $5 billion is more than 4 percent of $2.4, especially in light of inflation.

With the allotment formula that was put in place in the 1981 amendments, in fact, some States have even been reduced further because of the distribution of funding. Therefore, many States are suffering. They are not receiving more money this time around. They are receiving less.

Mr. SCHEUER. Thank you.

Mr. Carcich?

Mr. CARCICH. Let me add one more item. In New York State, this year alone, we had to reduce the quality control/quality assurance unit because of lack of 106 funds. As you mentioned this morning, additional reductions are to occur.

If basic information is to be obtained, a very strong quality control/quality assurance program must be implemented. EPA is telling us this; yet, on the one hand they are telling us that we must have a program that will provide accurate scientific information, and on the other hand, we do not receive the type of funds that are needed to implement such a program.

Mr. LUE-HING. I have some comments, Mr. Chairman.

Mr. SCHEUER. Yes.

Mr. LUE-HING. Again, I cannot speak for the State of Illinois, but I can give you a perspective from the local level. If we distribute the $24 million equally among the States, we are talking about less than half a million per State.

The pretreatment program that we maintain in Chicago—just to buy the equipment for doing the analysis for the organic priority pollutants, we have just spent $600,000 to purchase the equipment. To run those systems we will have to spend almost $200,000 a year for salaries.

The EPA has identified a long list of organic priority pollutants. Although we are required at the local level to monitor and measure these pollutants, the EPA does not have a list of methodology that anybody agrees on that is necessary to test for these pollutants.

We are saying that we can do it if you can give us the information how best to test at the least cost, the information which gives us systems of testing so that we can agree that the systems that we have in place, do in fact, have the capability to remove these pollutants as we think they can.

Therefore, it is a matter, again, of stressing the need for the Federal role in developing this information for use at the State and local level.

Mr. THOMAS. Mr. Chairman?

Mr. SCHEUER. Yes.

Mr. THOMAS. I think that I am the one panelist who has not responded to Congressman Carney's original question and your question. Let me make a very brief response to that question simply by saying that we believe that the Federal Government, State and local governments, and private industry have a place in the research picture.

I think that you stated it very eloquently this morning in reference to the Science Advisory Board in that each of these segments has unique talents, has unique specialties which it can bring to bear on this question of R&D.

I think that it is only appropriate that all of those segments participate in the efforts if we are to get good science, which I think that all of us agree is the necessary basis.

Mr. SCHEUER. Do any of you wish to respond further to my general question as to what result you think will flow from the administration's approach to water pollution control as expressed by the Assistant Administrator here this morning, namely, the cut of 40 percent in the EPA's research budget and the cut of 20 percent in the section 106 funds, and the different approaches that you heard this morning from Dr. Hernandez—the different elements and their suggested program for a shift of resources, shift of responsibility from the Federal Government to the cities and States?

In other words, do any of you wish to react to any of the elements or all of the elements of the new Federal program as he described them? Are they heading in the right direction?

Mr. **Carcich**. What I would like to propose is that we submit an analysis that was performed by a number of States with the National Governors' Association [NGA] and enter that into the record.

Mr. **Scheuer**. Very good. If you can get that in in the next 10 or 12 days, we will hold the record open.

[Analysis to be submitted by Mr. Carcich follows:]

The State of the States: Management of Environmental Programs in the 1980's

Based on a Survey Jointly Conducted by:

The NGA Energy and Environment Committee
The State and Territorial Air Pollution Program Administrators
The Association of State and Interstate Water Pollution Control Administrators, and
The Association of State and Territorial Solid Waste Management Officials

May 1982

This report was prepared by Thomas W. Curtis of the National Governors' Association Energy and Environment Committee, under the direction of Edward A. Helme, Staff Director. Research assistance was provided by Peter Creedon of the NGA Energy and Environment Committee. Special thanks are owed to Bill Becker and Ann Renauer of the State and Territorial Air Pollution Program Administrators, Robbi Savage and Lynn Eichmiller of the Association of State and Interstate Water Pollution Control Administrators, and David Duncan of the Association of State and Territorial Solid Waste Management Officials.

Energy and Environment Committee
National Governors' Association
400 North Capitol Street, N.W.
Washington, D.C. 20001

The State of the States:
Management of Environmental Programs in the 1980's

Background

The landmark environmental legislation enacted in the 1960's and 70's helped establish a state-federal partnership in the management and protection of environmental quality. The partnership involved a division of responsibility for environmental programs, with the Environmental Protection Agency providing funds to assist state agencies develop and administer federally mandated programs for managing air and water quality, hazardous waste, pesticides, and water supply. In fiscal year 1982, the federal assistance for these management programs totaled $227.8 million, and represented approximately 50% of total state expenditures on these activities. These figures do not include state or federal expenditures for the construction of sewage treatment plants.

For fiscal year 1983 the Administration has proposed reducing funds which support state management of environmental programs by 20%, and may propose further reductions in future years. In proposing these cuts, the Environmental Protection Agency has assumed that all environmental programs are now adequately funded and that improved management practices can reduce the cost of environmental programs without lowering the quality of environmental protection. Although states have indicated a willingness to assume greater responsibilities for environmental program management, the proposed 20 percent cutback comes at a time when most state budgets are reflecting the twin effects of last year's federal budget cuts and the continued recession. At least two-thirds of the states are experiencing revenue shortfalls from earlier projections. Virtually every state legislature meeting this year has raised taxes and/or made significant cutbacks in government activities while straining to cope with major reductions in federal support for human service programs. At the same time, the states have already absorbed inflation related "budget cuts" in environmental programs, because of relatively flat funding over the past several years and an actual reduction in funding in FY 1982. State environmental program managers have streamlined their programs over the past several years and eliminated inefficiences. This situation increases the difficulty of absorbing even relatively small cutbacks in federal support.

In order to assess the ways in which states will respond to the proposed reductions in federal support, the National Governors' Association Energy and Environment Committee, chaired by Governor Jay Rockefeller (WV), undertook a survey of states' management of environmental programs, in cooperation with the State and Territorial Air Pollution Program Administrators (STAPPA), the Association of State and Interstate Water Pollution Control Administrators (ASWIPCA), and the Association of State and Territorial Solid Waste Management Officials (ASTSWMO). The survey focused on sources of funds for environmental programs, with particular regard to permit fees and other non-federal sources, and on changes in management practices that the states anticipate if federal support is reduced. The survey covers state air program grants under section 105 of the Clean Air Act; water quality management grants under sections 106 and 205(g) of the Clean Water Act; hazardous waste management grants under section 3011 of the Resource Conservation and Recovery Act; and water supply management grants under section 1443 of the Safe Drinking Water Act.

Summary of Findings

The survey strongly suggests that in most states, a 20% reduction in federal support would require curtailment in a number of environmental protection activities by a level at least proportionate to the reduction in federal support. Because states may still be required to respond to federal mandatory requirements, the activities most likely to be curtailed by the states include resource intensive activities such as monitoring of ambient pollution levels, monitoring of compliance by emission sources, permitting, technical support, and enforcement, in all environmental media (air,water quality, and hazardous waste). A significant number of state agencies would seriously consider eliminating, not accepting delegation of, or returning to the federal government several environmental protection activities. This particularly applies to air programs, including PSD permitting, control of toxic pollutants, vehicle inspection and maintenance programs, and the development of emission trading systems. Some of these activities, such as emission trading systems, air quality banking, and bubble programs, could substantially reduce the cost of compliance for emission sources, but increase the states' cost for environmental program management. The survey also suggests that personnel reductions may in many states increase the time required for sources subject to regulation to obtain permits. The survey suggests that in the short run most states will not be able to increase non-federal sources of funds, including state appropriations and collections from permit fee systems, to make up for the reduction in federal support. Finally, most states suggest a strong need to increase their efforts in certain areas, such as toxic pollutant control, if increased resources were available. Such expanded activities will not be possible in the face of reduced federal support.

Findings

The survey has revealed a number of facts germane to the debate about how, and how much, federal support for state environmental management activities could be reduced without reducing the ability of states to adequately implement federal environmental programs. The salient findings include the following facts:

- Federal support plays an important role in environmental program management. While the figures vary widely from state to state, in aggregate terms federal funds provide about 45% of state air program budgets, about 46% of state water quality program budgets, about 69% of state hazardous waste program budgets, and about 48% of state water supply program budgets. The states have increased their support of environmental programs as the programs progress from the planning stage to implementation, but federal support remains important. See Table I.

- Only a small number of states expect to be able to make up for a 20% reduction in federal support by increasing state funds, in the face of their own severe financial constraints. Six states hope to be able to make up at least part of the reduction in air program funds. Three states indicate the possibility of increased support to make up for at least part of the reduction in water quality grants, 11 states hope to replace at least part of the reductions in hazardous waste grants, and 6 states hope to make up for at least some of the reduction in support for water supply programs. Given the continuing pressures on state budgets, these figures may be optimistic.

- Most state environmental agencies will not be able to rely on permit fees to provide funds for environmental programs, at least in the short run. Many states do not have existing statutory authority to collect permit or processing fees. About 21 states and territories currently charge for air quality permits, but in only 10 are the funds available to the permitting agency. In only 9 states and territories are water quality permit fees available to the permitting agency; only 7 hazardous waste agencies collect and keep permit fees, and only 2 water supply agencies actually keep permit fees. In other states which charge permit fees, revenues are deposited in the state general fund. Indeed, in most states it has historically been considered good public policy to place such revenues in the general fund to avoid the appearance of conflict of interest between regulators and emission sources. Given the budget pressures in most states, collections may not go to the environmental management agency even where permit fee programs are established or fees are increased. See Tables II-V.

o Most states suggest the need to increase their efforts in a number of key for states to develop more vigorous programs in these areas without retrenchment elsewhere. Those areas most frequently mentioned by the states as needing increased effort if federal funds for environmental programs were increased include:

Air: increased toxic emissions control, increased inspections and monitoring, increased enforcement, development of bubble and controlled trading systems, and increased staff for permit processing;

Water Quality: development of groundwater management mechanisms, increased water quality monitoring and bio-assay analysis, enhancement of toxic pollutant control programs, increased resources for sewage treatment plant operator training and technical assistance, and strengthening the NPDES permitting program;

Hazardous Waste: increased investigations of uncontrolled and abandoned waste sites, increased compliance monitoring, increased enforcement, increased efforts to protect groundwater, and increased staff for permit processing;

Water Supply: increased monitoring and inspections of municipal water systems, increased resources for water treatment plant operator training, increased technical assistance, and increased resources for small and non-community water supply protection.

o A significant number of states expect a delay in the time necessary to process and issue permits under federal environmental statutes as a result of the reduction in federal support for environmental program management. In other states, many of which are subject to mandatory time limits for issuing permits, the quality of permit review is expected to decline. About 27 states have indicated they expect the time necessary to issue air permits to increase by an average of about 24%. About 18 states also expect water quality permitting time and about 19 states expect hazardous waste permitting times to increase. These figures are tentative because many states are not yet certain whether or by how much their permit processing time will be increased by cuts in program budgets.

o A large number of state agencies indicate that they are considering completely eliminating, not accepting delegation of, or turning back to the federal government certain important environmental protection activities, particularly in the air program. At least 11 states may eliminate or turn back

PSD permitting in the air program, and 7 states may eliminate their activities to control toxic air emissions. At least 10 states indicate they will not have the resources to develop air emissions bubble and banking systems, which can reduce compliance costs for the business community but which increase the costs to state regulatory agencies. These findings raise questions about the states' capacity to assume programs for which they currently do not have delegation, such as hazardous waste management and underground injection control, in which the Administration would like the states to assume greater responsibility.

o In addition, a large number of states have indicated that they may reduce certain environmental management activities proportionately to the reduction in federal support or more. This reflects the states' belief that they have already streamlined state programs and that significant further savings cannot be expected from management changes alone. Many states indicate that budget reductions will require actual reductions in personnel and equipment. At least 36 states indicate that they will reduce ambient air quality monitoring proportionately to the reduction in federal budget support or more; 25 states will reduce water quality monitoring proportionately or more, while 20 states will reduce hazardous waste monitoring proportionately to the reduction in federal support or more. Other important activities including enforcement, toxic air pollutant control, general and PSD permitting, determinations of source compliance, technical support, and the development of emission trading systems, will also be reduced at least proportionately to the federal cuts in significant numbers of states. In addition, program development, including the development of 1982 air program implementation plans for both mobile and stationary sources, will be curtailed proportionately to the federal cuts or more in a number of states. See Tables VI-IX.

Table 1 FY 1982 Federal Support of Environmental Programs
(% of total program costs)

	AIR	WATER QUALITY	HAZARDOUS WASTE	WATER SUPPLY
ALABAMA	60			
ALASKA	53	35	40	45
ARIZONA	48	81		77
ARKANSAS	54	55	75	75
CALIFORNIA	10	38		
COLORADO	32	55	58	56
CONNECTICUT	60	75	100	
DELAWARE	59	63	67	75
FLORIDA	24	13	89	48
GEORGIA	49	51	75	43
HAWAII	59	48	85	61
IDAHO		79	82	76
ILLINOIS	63	70		61
INDIANA	57	32	75	0
IOWA	71	62	62	0
KANSAS	75	52	73	66
KENTUCKY	43	38	28	80
LOUISIANA	44	17	59	29
MAINE	62	58	100	62
MARYLAND	45	56		87
MASSACHUSETTS	62	64	48	41
MICHIGAN	38	51	69	45
MINNESOTA	52	54	41	44
MISSISSIPPI	60	51	59	75
MISSOURI	64	89	60	
MONTANA	68	87	86	79
NEBRASKA	75	86	75	60
NEVADA	52	64	68	60
NEW HAMPSHIRE	74	90	39	70
NEW JERSEY	45			66
NEW MEXICO	61	25	75	59
NEW YORK	67			
NORTH CAROLINA	51	44	74	54
NORTH DAKOTA	51	68	75	75
OHIO	74			
OKLAHOMA	63	78	66	47
OREGON	36	42	78	0
PENNSYLVANIA				
RHODE ISLAND	73	75		75
SOUTH CAROLINA	49	31	59	36
SOUTH DAKOTA	74	69	83	
TENNESSEE	40	35	58	58
TEXAS	30	35	81	43
UTAH	75	56	71	53
VERMONT	75	78	100	38
VIRGINIA	44	21	73	46
WASHINGTON	51	66	73	55
WEST VIRGINIA	52	50	75	51
WISCONSIN	51		75	
WYOMING	56	56		
AMERICAN SAMOA				
GUAM				
PUERTO RICO	77	56	72	75
VIRGIN ISLANDS				
DISTRICT OF COLUMBIA				
NORTHERN MARIANA ISLANDS				

Table II

AIR QUALITY PERMITTING FEES

	Does the state have authority to collect air permitting or processing fees?	Does the state actually collect air permitting fees?	Does the state intend to develop authority or collect fees in the near future?	Is the fee available to the permitting agency?	What percent of the agency's operating budget is provided by the fee?
ALABAMA	no				
ALASKA	no				
ARIZONA	yes	yes		no	
ARKANSAS	no		yes FY83		
CALIFORNIA	yes	yes		local agencies	varies
COLORADO	yes	yes		no	
CONNECTICUT	yes	no	yes-FY 83		
DELAWARE	yes	no	yes		
FLORIDA	yes	yes		no	
GEORGIA	yes	no			
HAWAII	yes	yes		no	
IDAHO					
ILLINOIS	yes	no	proposed		
INDIANA	yes	yes		no	
IOWA	yes	no			
KANSAS	no				
KENTUCKY	yes	yes		yes	5%
LOUISIANA	yes	yes		yes	13%
MAINE	yes	yes		no	
MARYLAND	yes	no	yes FY 83		
MASSACHUSETTS	no		yes FY 83		
MICHIGAN	yes	yes		yes	45%
MINNESOTA	no				
MISSISSIPPI	no				
MISSOURI	yes	yes		no	
MONTANA	yes	no			
NEBRASKA	yes	no			
NEVADA	yes	yes		no	
NEW HAMPSHIRE	yes	yes		yes	7%
NEW JERSEY	yes	yes		no	
NEW MEXICO	yes	no			
NEW YORK	yes	yes		yes	n/a [2]
NORTH CAROLINA	yes	no			
NORTH DAKOTA	yes	yes		yes	11%
OHIO	yes	yes		no	
OKLAHOMA	yes	yes		yes	under 1%
OREGON	yes	yes		yes	49%
PENNSYLVANIA	yes	no	proposed for FY83		
RHODE ISLAND	no				
SOUTH CAROLINA	no				
SOUTH DAKOTA	no				
TENNESSEE	yes	no			
TEXAS	yes	no	yes FY 83		
UTAH	yes	yes		no	
VERMONT	no		considering		
VIRGINIA	no				
WASHINGTON	no		will propose 84		
WEST VIRGINIA	no				
WISCONSIN	yes	no	proposed for FY84		
WYOMING	no				
AMERICAN SAMOA					
GUAM	no				
PUERTO RICO	yes	yes		yes	
VIRGIN ISLANDS					
DISTRICT OF COLUMBIA					
NORTHERN MARIANA ISLANDS					

[1] Program will be phased out by FY 1985

[2] Program recently authorized and has not yet generated any revenue.

TABLE III

Water Quality Permitting Fees

	Does the state have authority to collect water quality permitting fees?	Does the state actually collect water quality permitting fees?	Does the state plan to develop authority or collect fees in the near future?	Is the fee available to the permitting agency?	What portion of the agencies operating budget is provided by the fee?
ALABAMA					
ALASKA	no				
ARIZONA	no				
ARKANSAS	no		yes 1983		
CALIFORNIA	yes	yes		yes	10%
COLORADO	yes	yes		yes	13%
CONNECTICUT	no				
DELAWARE	yes	no	yes		
FLORIDA	yes	yes		no	
GEORGIA	no				
HAWAII	yes	yes		no	
IDAHO	yes	no			
ILLINOIS	yes	no			
INDIANA	yes	yes		no	
IOWA	yes	no			
KANSAS	yes	yes		no	
KENTUCKY	yes	no	yes		
LOUISIANA	yes	yes		yes	17%
MAINE	yes	yes		no	
MARYLAND	yes	yes		no	
MASSACHUSETTS	yes	no	yes		
MICHIGAN	yes	no			
MINNESOTA	no				
MISSISSIPPI	no				
MISSOURI	yes	yes		yes	under 1%
MONTANA	no				
NEBRASKA	yes	no	proposed		
NEVADA	yes	yes		yes	under 1%
NEW HAMPSHIRE	no				
NEW JERSEY	yes	yes		yes	100%
NEW MEXICO	no				
NEW YORK					
NORTH CAROLINA	no				
NORTH DAKOTA	no				
OHIO					
OKLAHOMA	no				
OREGON	yes	yes		yes	5%
PENNSYLVANIA					
RHODE ISLAND	no		proposed		
SOUTH CAROLINA	no				
SOUTH DAKOTA	no				
TENNESSEE	no				
TEXAS	yes	yes		no	
UTAH	no				
VERMONT	yes	yes		yes	under 1%
VIRGINIA	no				
WASHINGTON	yes	no			
WEST VIRGINIA	yes	yes		no	
WISCONSIN					
WYOMING	no				
AMERICAN SAMOA					
GUAM	no				
PUERTO RICO	yes	yes		yes	
VIRGIN ISLANDS					
DISTRICT OF COLUMBIA					
NORTHERN MARIANA ISLANDS	yes	yes		no	

TABLE IV

Hazardous Waste Permitting Fees

	Does the state have authority to collect hazardous waste permitting or processing fees?	Does the state acutally collect such fees?	Does the state intend to develop authority or collect such fees in the near future?	Are fee collections available to the permitting agency?	What portion of the agency's operating budget is provided by the fee?
ALABAMA					
ALASKA	no				
ARIZONA	no				
ARKANSAS	yes	no			
CALIFORNIA					
COLORADO	no				
CONNECTICUT	no				
DELAWARE	yes	no			
FLORIDA	yes	no			
GEORGIA	no				
HAWAII	yes	yes		no	
IDAHO	yes	no	proposed		
ILLINOIS	yes	yes			
INDIANA	yes	no			
IOWA	no				
KANSAS	yes	yes		no	
KENTUCKY	yes	yes		no	
LOUISIANA	yes	yes		yes	59%
MAINE	yes	no	proposed		
MARYLAND					
MASSACHUSETTS	yes	yes		no	
MICHIGAN	yes	yes		no	
MINNESOTA	no				
MISSISSIPPI	no				
MISSOURI	yes	yes			
MONTANA	yes	no			
NEBRASKA	yes	no			
NEVADA	yes	no			
NEW HAMPSHIRE	yes	yes		yes	n/a
NEW JERSEY	yes	yes		no	
NEW MEXICO	yes	no			
NEW YORK					
NORTH CAROLINA	no				
NORTH DAKOTA	no				
OHIO					
OKLAHOMA	no				
OREGON	yes	yes		yes	14%
PENNSYLVANIA					
RHODE ISLAND	yes	yes		yes	N/A
SOUTH CAROLINA	no				
SOUTH DAKOTA	no				
TENNESSEE	yes	yes		no	
TEXAS	yes	yes			
UTAH	no				
VERMONT	no				
VIRGINIA	no				
WASHINGTON	no				
WEST VIRGINIA	yes	yes		yes	n/a
WISCONSIN	yes	yes		yes	11%
WYOMING					
AMERICAN SAMOA					
GUAM	no				
PUERTO RICO	yes	yes		yes	
VIRGIN ISLANDS					
DISTRICT OF COLUMBIA					
NORTHERN MARIANA ISLANDS					

Table V

Water Supply Permitting Fees

	Does the state have authority to collect water supply permitting or processing fees?	Does the state actually collect such fees?	Does the state intend to develop authority or collect fees in the future?	Is the fee available to the permitting agency?	What portion of the agency's operating budget is provided by the fee?
ALABAMA					
ALASKA	no				
ARIZONA	no				
ARKANSAS	yes	yes		no	
CALIFORNIA					
COLORADO	no				
CONNECTICUT					
DELAWARE	no				
FLORIDA	yes	no	proposed		
GEORGIA	no				
HAWAII	no				
IDAHO	no				
ILLINOIS	yes	no			
INDIANA	yes	no			
IOWA	no				
KANSAS	yes	yes		no	
KENTUCKY	yes	no			
LOUISIANA	no				
MAINE	no				
MARYLAND	yes	no			
MASSACHUSETTS	yes	yes		yes	under 1%
MICHIGAN	yes	no			
MINNESOTA	no				
MISSISSIPPI	no				
MISSOURI	no				
MONTANA	no				
NEBRASKA	yes	yes		yes	15
NEVADA	yes	no	yes FY 84		
NEW HAMPSHIRE	no	no			
NEW JERSEY	no		investigating		
NEW MEXICO	no				
NEW YORK					
NORTH CAROLINA	no				
NORTH DAKOTA	no				
OHIO					
OKLAHOMA	no				
OREGON	no				
PENNSYLVANIA					
RHODE ISLAND	no				
SOUTH CAROLINA	no				
SOUTH DAKOTA	no				
TENNESSEE	no				
TEXAS	no				
UTAH	yes	no	yes FY 84		
VERMONT	no				
VIRGINIA	no				
WASHINGTON	no				
WEST VIRGINIA	no				
WISCONSIN					
WYOMING					
AMERICAN SAMOA					
GUAM	yes	yes		no	
PUERTO RICO	no				
VIRGIN ISLANDS					
DISTRICT OF COLUMBIA					
NORTHERN MARIANA ISLANDS	no				

Table VI
States' Response to a 20% Reduction in Federal Support

Air Programs

Environmental Program Activity	Eliminate Activity	Reduce Proportionately to Budget Cut or More	Not Reduce Activity
	Number of States		
General Permitting	2	27	12
PSD Permitting	11	21	11
Compliance Determination	1	33	5
Enforcement Against Non-Complying Sources	1	26	13
Toxic Emission Control	7	14	9
Ambient Air Quality Monitoring	1	36	2
Emissions "bubbles"	8	17	9
Emissions "banking"	10	14	4
'82' SIP Development (Stationary)	3	16	3
'82' SIP Development (Mobile)	4	14	3
I/M	4	8	6
Other	0	12	2

Table VII

States' Response to a 20% Reduction in Federal Support

Water Quality Programs

Environmental Program Activity	Eliminate Activity	Reduce Proportionately to Budget Cut or More	Not Reduce Activity
	Number of States		
Program Development	0	26	7
Permitting	1	17	6
Compliance Monitoring	0	25	4
Enforcement	0	20	7
Technical Support	0	19	5
Other	2	10	2

Table VIII

States' Response to a 20% Reduction in Federal Support

Hazardous Waste Programs

Environmental Program Activity	Eliminate Activity	Reduce Proportionately to Budget Cut or More	Not Reduce Activity
	Number of States		
Program Development	2	21	8
Permitting	1	16	7
Compliance Monitoring	1	20	6
Enforcement	1	15	9
Technical Support	1	19	5
Other	2	12	1

Table IX

States Response to a 20% Reduction in Federal Support

Water Supply Programs

Environmental Program Activity	Eliminate Activity	Reduce Proportionately to Budget Cut or More	Not Reduce Activity
	Number of States		
Program Development	1	11	8
Permitting	0	4	12
Compliance Monitoring	0	12	7
Enforcement	1	16	3
Technical Support	2	8	9
Other	0	4	1

Dr. LUE-HING. Mr. Chairman, I think that Dr. Hernandez has some views which are encouraging in terms of the need to improve the quality of science within his agency. I share this view with Dr. Hernandez. I am a past member of the EPA Science Advisory Board, and I supported that concept while I was a member of the Board. I do find a conflict in his desire to improve the science at the same time that the ability even to generate scientific equipment is being curtailed. I think that we can only improve information that we generate. If we are not generating information or we are not able to generate information that we need, then I am not sure there is much that we can improve on.

Therefore, while his philosophy is good and I support that, I am not sure that we can get the information that we all think we need with the drastic reduction in R&D funding, particularly in the areas that AMSA is concerned about.

Mr. SCHEUER. Do any other members of the panel wish to respond?

Dr. Gloyna, have you presented your views on this, your general reaction to the administration's program—their direction?

Mr. GLOYNA. I think that the point that we made earlier that we are very concerned about the quality of science, and we support the general intention of moving in the direction of providing quality science in support of the projects is very well established. The mechanism of providing the funds is, I think, one that must be given priority attention.

Mr. SCHEUER. Where do you think those funds ought to come from? Can we rely on industry to provide those funds? Can we assume that funds will be available at the city and State level, or should we continue to look to the Federal Government for funding of this kind of research?

Mr. GLOYNA. Ultimately, I suppose that we are each going to carry our own share of that funding effort. There are many models that have been used that haven't been tried in the water areas yet. One of them is the research effort that supports the highway program. All of the universities—some of the major universities and major industrial operations and government at different levels have participated in that particular program and it has been very effective.

Mr. SCHEUER. Well, given the scientific and technical information that is available, is the administration's approach really achievable—their regulatory approach? In other words, changing to a water quality-based standard from the BAT standard, given the existing knowledge base, the existing technology, is this approach workable and doable, and will it serve our goal of improving water quality?

Mr. GLOYNA. The approach is doable. The rate at which we will achieve the answers is one which may be questionable because therein lies the problem of how fast do we want to achieve the answers and how fast do we need to obtain answers.

Mr. SCHEUER. Now, if the rate at which we are going to make progress is going to be slowed down, it is going to increase the time by which we achieve the kind of water quality we want for our country. Is that a reasonable and prudent change now? Is that justified if the cost is going to be a considerable slowing down of progress?

Mr. GLOYNA. Well, I don't think that transferring from the Federal Government to the States and putting the emphasis in that direction is necessarily going to slow the effort. In some areas, it may require a new set of priorities. I think therein lies some of our problems, and that is the reason that we concentrated on the sludges and toxic materials.

Mr. SCHEUER. Does anybody else wish to make a contribution at this point on some of the matters that we have been discussing?

Dr. LUE-HING. Yes.

Mr. SCHEUER. Please proceed Dr. Lue-Hing

Dr. LUE-HING. To your last question to Dr. Gloyna, "Where should the effort originate?" I think that while each State or region might have problems unique locally, the major thrust comes from the Federal Government. Many States and many regions do share generic problems. If we get into a situation where each State and each local community generates its own research program, that would only not be wasteful but expensive and impractical.

We believe that there is a very strong role that the central agency can play in addressing these national generic problems through proper research. It is much more efficient and much more cost effective for it to be done this way.

Mr. SCHEUER. For it to be done which way?

Dr. LUE-HING. At the Federal level.

Mr. SCHEUER. Yes.

Mr. LUE-HING. Assistance should come from the Federal level because there are generic problems that need resolution.

Mr. SCHEUER. Both the funding and the actual research should be performed at the Federal level?

Mr. LEU-HING. Yes, I do agree with my colleague here from industry that there is a role for each unit to play in this game: the local governments, industry, and the Federal Government. However, I think that the major role for R&D information to meet national water pollution goals should be at the Federal level.

Mr. SCHEUER. Thank you.

Mr. Thomas, would you like to give the industry point of view on how the research and development effort should be organized? Should it be done by government? If so, at what level, and how should it be funded, or should it be done by industry? If so, how should it be funded?

Mr. THOMAS. Well, as I stated, I believe there is a role for everyone. I certainly agree with my colleague that there are certain issues that are national in scope which can best be studied on a Federal level in order to avoid duplicative efforts by States and regions.

Mr. SCHEUER. What kinds of things? Would you be a little more specific?

Mr. THOMAS. I don't believe that I am prepared at this time to list specific items. I would be happy to submit those for the record.

Mr. SCHEUER. We shall submit some written questions to you so that we can have those specific items for the record.

Mr. SCHEUER. Would you like to complete your comments?

Mr. THOMAS. I think that there are other interests specific to various States and various regions which are not national in scope and which are rightly the purview of those local and State governments.

Again, I am not prepared to discuss specifics, but I would be happy to submit some of those for the record as well. I think that perhaps some of those are obvious.

Mr. SCHEUER. All right, very good. Again, we will submit written questions and keep the record open for 10-12 days so that you have enough time to respond.

This has been a very interesting panel, and we have kept you until late in the morning. Does anybody wish to make a closing statement?

Mr. CARCICH. I have one last comment, please.

Mr. SCHEUER. Yes.

Mr. CARCICH. I think that New York State and the association sympathizes with the budget problems that we are facing. I think that we are willing and have been on a daily basis working with EPA in order to discover new management techniques and new program economies. The States in general, I think, support the delegation of additional responsibility. However, that delegation must be made on the basis of a stable and adequate level of funding. I think that is one very important point that we must face.

The Governors' Association supports, for instance, the 1982 level of funding, but we really question whether we can do the things that are required under the various delegation programs.

Mr. SCHEUER. Thank you.

Dr. Gloyna?

Mr. GLOYNA. Yes, Mr. Chairman. We would like to leave with the committee two copies of the reports that I mentioned: One on sludge disposal and one on toxic management. That will conclude our comments then.

[Reports retained in subcommittee files.]

Mr. SCHEUER. Very good.

This has been a very helpful panel, and we appreciate your patience and your forthrightness. The committee will now adjourn.

[Whereupon, at 12:31 p.m., the subcommittee recessed, to reconvene at the call of the Chair.]

APPENDIX I

QUESTIONS AND ANSWERS SUBMITTED FOR THE RECORD

Questions for Mr. Thomas C. Jorling

1. The Administration has proposed amendments that would extend the promulgation and compliance deadlines for Best Available Technology (BAT) and Best Conventional Technology. Do you feel these extensions are justified?

2. EPA has repeatedly missed its court ordered timetable for issuing effluent guidelines for industrial and municipal BAT and Pretreatment requirements. What has caused these delays? Does EPA have the necessary scientific, technical, and the administrative expertise to promulgate these standards? Do you believe they intend to promulgate these guidelines?

3. EPA has reduced its proposed FY 1983 funding for research and technology in support of the Clean Water Act by 40% from FY 1982 appropriations. This proposed FY 1983 funding represents a 60% reduction from FY 1980 appropriations. What do you feel are the long term implications of these cuts to achieving the goals of the Clean Water Act?

4. The Administration is amending the Clean Water in the areas of deadlines, pretreatment, and exemptions from certain requirements. If these amendments were incorporated into the Act, what would be the result to water quality? How would these amendments affect toxic pollution control efforts?

5. Your testimony states that the Administration is refusing to regulate further control of toxic chemicals until conclusive scientific evidence proves their harmful, but EPA's budget is being cut to prevent the development of this information. Could you give us some specific examples of this?

6. Your testimony mentions that industrial and municipal discharge related research be a "cost of doing business" and that government research be directed to water pollution abatement where no clear cut "producer" exists (e.g., nonpoint pollution). How would these ideas be incorporated into the research provisions of the Clean Water Act?

7. How should Congress act on reauthorization of the Clean Water Act?

8. Your oral testimony mentioned that the "Japanese are not relaxing their environmental controls, and yet they are out-competing us in the marketplace." What specific examples of this fact can you provide, along with the sources of this information?

9. Your comments during the question and answer period mentioned that you would "... urge that Congress not take steps that would reward poor performance. The achievement that has been made by those people out there should be rewarded, and that means everyone should be brought up to that level. The administration's amendments, when taken in general, have the effect of bringing the good performers down to the poor performers. I think Congress should reject that."

   - o Specifically, who are the "good" and "poor" performers?
   - o What congressional action would you recommend to ensure compliance by those selfish elements of corporate leadership?
   - o How should Congress act to encourage, recognize, and reward those elements of the corporate community that are complying with the letter and spirit of the Clean Water Act?

ANSWERS TO QUESTIONS

Question 1

I believe some adjustment is necessary. But the adjustment should represent a fine scalpel approach. I believe all guidelines should be promulgated by July 1, 1983, and the compliance period should be no later than three years after that date. It is imperative to keep the Agency performing and Congress should support the courts in this regard. The malfeasance of the Agency has been so great as to suggest the appropriateness of the court's putting the Agency in receivership or trusteeship in order to carry out the law.

Question 2

The effluent guideline program at the end of the Carter Administration had the necessary resources to complete the task. The new Administration has apparently cut back not just on resources (and in the effluent guideline program apparently not greatly yet) but more importantly it has sent a message that it has neither the interest nor the will to carry out its statutory assignment. Their performance to date can only suggest pandering to the regulated industries. Already some industries, such as American Cyanamid, have concluded that environmental protection is no longer a serious program, and have disbanded their environmental control program.

Question 3

Unless these cuts are reversed quickly, they will have disastrous effects. Achievements will be reversed; investment will decline; professional staff will be lost. This country made significant strides in protecting its future. The new Administration is jeopardizing that for no real reason. It is outrageous and sad.

Question 4

The amendments would basically ratify the current administrative posture of EPA in regard to the statute -- that is to do nothing. Thousands of pounds of toxic chemicals are being discharged into the nation's environment. The law calls for ending such practices. So far the new Administration has not acted to remove even a pound of those pollutants.

Question 5

I would defer on specifics to the various analyses of the EPA budget that have been made recently and that I am sure have been made available to the Committee. I would only add that the havoc that has been wrought on the EPA water labs in Cincinnatti, Duluth and Corvallis has drastically weakened the corps of analytical water quality talent that exists in this country.

Question 6

I believe as a general matter that sufficient authority exists. The key now is in applying budget and policy to that end. Congress could certainly add a specific directive in Section 105 on its views on EPA's research priorities.

Question 7

My own view is that the amendments should be limited to a 3-5 year reauthorization plus very minor and precise extensions of dates.

Question 8

Specifically, I was referring to the Japanese position on auto emission standards. The Japanese have indicated to the U.S. they will not relax their standard (modelled on the U.S.) notwithstanding what the U.S. does to relax them. Their competitive edge in autos is self evident.

I believe examples in water pollution control exist especially in the steel manufacturing area.

Question 9

As a general matter, Congress rewards the good performers by insisting on vigorous enforcement against poor performers, accompanied by penalty provisions that capture any economic advantage gained by noncompliance.

Identifying specific plants or corporations as good or bad performers is difficult, and the question should be addressed to the compliance office of EPA. Often within a given corporation there are both good and bad performers.

As a general matter, steel and smelters have been poor performers; chemicals and petroleum refining have been good.

My own view is that good performers, i.e. corporate or individual citizens who comply with the law, should receive no special recognition. It should be the mode of behavior we expect as a matter of course. However, there are examples that should be documented and featured if for no other reason than to show the American people that notwithstanding the vocal rhetoric about "we can't do" that it can be -- and is being done.

Questions for Joe G. Moore, Jr.

1. Is water quality getting better or worse? Why? Has EPA's implementation of the Clean Water Act for the last 10 years improved water quality?

2. Have the technology based standards advocated by the 1972 amendments improved water quality?

3. What impact has the Clean Water Act of 1977 had on the control of toxic pollutants?

4. The Administration has proposed amending the Clean Water Act to allow Publicly Owned Treatment Works (POTW's) not in compliance with secondary treatment requirements or water quality based effluent limitations to apply for an extension to 1988. Do you feel this extension is justified? What number and percentage of POTW's function below secondary treatment levels? What effect does this non-compliance have on national water quality?

5. Your testimony raises some doubts as to the effectiveness of some of the regulations under the Clean Water Act to controlling water pollution. You also mention that billions of dollars have been spent on treatment works and water pollution programs that have had negligible results. What suggestions do you have to prevent these kinds of problems in the future?

6. The Administration and industrial groups are proposing more reliance on water quality-based standards for controlling toxic pollutants as opposed to the current technology-based standards required. Do you consider such a change wise given that our knowledge of the aquatic and health effects of toxic chemicals is poorly understood?

7. EPA's research and development program in support of the Clean Water Act has been proposed by the Administration to be reduced by 40% from FY 1982 funding in addition to drastic cuts in long term research. What effect do you feel these reductions will have on improving water quality?

8. How should Congress act in reauthorization of the Clean Water Act?

9. What research needs must be met in the 1980's to continue to understand and control water pollution?

10. Your testimony mentions that the inadequacies of our water quality monitoring system have made it part of our water quality problem. What specific recommendations do you have to make our water quality monitoring system more compatible and useful for interpretation and policy decision making?

11. Your testimony stated that an independent scientific body should periodically evaluate EPA's performance in the area of research intended to develop water quality regulations and testing methodologies. What group(s) would you recommend for this role? How would this group(s) evaluate EPA's performance?

ANSWERS TO QUESTIONS
FROM THE
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE, RESEARCH AND ENVIRONMENT, COMMITTEE ON SCIENCE AND TECHNOLOGY

July 19, 1982

1. Water quality is getting better throughout the United States primarily because those who wish to comply with the Clean Water Act and a host of dedicated professionals employed by dischargers and regulatory agencies have taken seriously the 1972 and 1977 statutes. Some of the evidence of improvement is "negative", i.e. it is evident that gross pollution incidents -- fish fills, for example -- do not occur as often or in the magnitude as they once did. While the EPA's implementation of the Clean Water Act for the last ten (10) years has improved water quality, much of the documented improvement has resulted from actions under Federal and State statutes in effect before 1972 and initiated before EPA's creation. EPA's preoccupation with detailed, explicit and complex regulations intended to cover every conceivable circumstance has probably delayed improvement in water quality. The regulation development and review process has been so time consuming and all encompassing as to produce frustration by persons anxious to achieve results by action rather than paper regulations.

2. I believe the technology based effluent standards required by the 1972 amendments have improved water quality. In fact, I believe such effluent limitations accurately translated to NPDES (National Pollutant Discharge Elimination System) permits are essential to effective point source pollution control. While the delays in publishing the standards have sometimes been inexcusable, the approach is sound and should be abandoned, if at all, only after careful forethought and development of an acceptable substitute.

3. The Clean Water Act of 1977 has probably had little demonstrable direct effect upon the control of toxic pollutants, except as a by-product of applying effluent limitations for conventional pollutants. The continued EPA focus upon what is, in my view, a mis-application of the 1972 Act's pretreatment requirements has precluded their effective use for the removal of toxic substances that might damage or pass through publicly owned treatment works. The promulgation of effluent limitations intended to remove priority pollutants identified in the

settlement of the NRDC ligitagtion on toxics is far behind schedule. Frankly, I believe what is needed is more NPDES permits for dischargers, including POTW's, which contain specific numerical limits for toxics.

4. Funding of the Federal construction grants program contained in Title II of the Clean Water Act has been so erratic that some extension of the deadline for compliance with secondary treatment by POTW's is probably justified. Whether the 1988 date is the appropriate one, I really don't know. Federal funding should be restricted to the actual construction costs for the treatment plants that are needed to achieve a universal national level of secondary treatment, excluding all collector and interceptor systems and costs for treatment more advanced than secondary. Completion of the goal of an adequate minimum level of treatment for all plants throughout the country should take precedence over other desirable construction projects.

5. Regulations that have had the effect of requiring the expenditure of millions of dollars examining every conceivable alternative to any part of a collection and treatment system have been applied by EPA so as to make the process an end in itself rather than a means to an end. Projects, regardless of how logical, reasonable or well developed cannot poceed until money is spent, usually for independent consultants, to document a checklist of regulations; ill-conceived projects with little merit are approved for construction so long as they have cleared every regulatory hurdle.

   The long controversy over whether oxidation ponds or lagoons met EPA's definition of secondary treatment wasted valuable energy at all governmental levels and was finally resolved by a decision that required no special expertise or analysis. The question of secondary treatment for deep ocean outfalls finally precipated the issue into Congress; even statutory authorization for a waiver in certain instances was frustrated for nearly five years by the resistance and opposition of EPA personnel. The inordinate bias of some EPA personnel toward land application of wastewater has caused the expenditure of Sec. 208 and 201 planning funds in many instances where such treatment was patently impractical.

Many of the Plants already constructed don't operate as they were claimed to be able to by their designers; many can not perform at design capacity. Excessive documentation to demonstrate compliance with the many complex EPA regulations is more often required by EPA personnel in a format and such detail as to provide protection to EPA monitors rather than to record an adequate analysis of the various possibilities.

Delegation of programs to State agencies has not provided any particualr relief, because State regulators are often more demanding of minutia than their EPA counterparts.

In retrospect, sophisticated biological wastewater treatment plants should have been required for the larger metropolitan areas and cities. Smaller municipalities, towns, areas, cities and villages should have been encouraged to utilize less complicated but effective treatment facilities. Recent (1981) statutory changes in Title II enunciate a policy for defining secondary treatment that is long overdue. The cost of operation for some small communities has proved exhorbitant. Now, all those in the field are confronted with absolute necessity to make all those that have been built function so as to redeem the investment already made.

6. I have difficulty supporting water quality-based standards for toxic pollutants. While it is true that toxicity is a matter of concentration as well as susceptibility or tolerance, I believe, we should continue a technology based effluent limitations approach for toxics, at least for the next five to ten years. Generators of toxic substances will reduce the toxicity of their production processes only if they are sensitive to the limits they must meet. Eventually, the volume generated or discharged should be reduced just as that for conventional pollutants has been. If that result does follow, then perhaps a water quality based standard might be considered.

7. Unfortunately, it is the long-term research that is often sacrificed first when agencies are faced with budget cuts; we thus sacrifice the future for the present,

a very short sighted solution in my view. The problems we now face with toxics may well have resulted from the exercise of a similar perspective in the past. To argue that we should move toward a wider application of water quality standards as opposed to technology based standards while reducing EPA's research budget are contradictory positions. We have repeatedly demonstrated that we poorly understand the nexus between the composition of individual wastewater discharges and their combined impact in the receiving water. Much about toxics remains to be learned and must be understood if we are adequately to control their introduction into the water environment. Inadequately funded or misdirected research with whatever funds are appropriated will delay water quality improvement.

8. I have some difficulty interpreting the question. Are you asking whether Congress should act this year or next year, i.e. sooner rather than later? In general, I believe attention should be focused upon Title III, the effluent limitations and water quality standards parts of the Act. Congress should specifically review what EPA has done, and is doing, with pre-treatment and toxic pollutant effluent limitations. The state-of-the-art of instrumentation and testing methodologies for accurately detecting toxic pollutants in very low concentrations should be reviewed; EPA's efforts, through contract and in-house research, in these areas should be evaluated. I do not believe it is fruitful to expend energy reexamining the Act's goals in Section 101, despite the agitation in some quarters for such review. The definitions section in Title V should perhaps be reviewed. There are, I think, extraneous provisions throughout the Act, the removal of which would provide a more orderly statute, but I don't know that their removal would produce a detectable benefit. In any event, Congress should probably attempt to provide some additional statutory guidance in the 1982 calendar year.

9. I do not believe I have anything to add that I have not already said here or in my appearance before the Sub-committee.

10. The existing monitoring stations, as well as the parameters measured, should be reviewed within each EPA region by a joint review team consisting of representatives from all federal, state, regional and local agencies having responsiblity for any of the monitoring activities. Special attention should be given to adding or eliminating stations and parameters consistent with current and future data needs. Even if present financing is not adequate to meet every data need, a minimal national monitoring network should be planned. The plans should then be reviewed at least every five years by a national team of persons expert in the field to keep the network up-to-date.

    Unfortunately, some poor data has been entered into the present national data bank. An effective means of data quality control should be instituted (if it has not already been) and entry of data should be policed so as to protect the integrity of the national system. Meanwhile, inaccurate or poor data should be purged from the system. In addition to ambient (in stream or lake) water quality data, information on the quantity and quality of wastewater authorized to be discharged into the nation's waters under individual NPDES permits should be entered. To my knowledge, it is still impossible, for example, to compare the actual permit conditions for the some fifty oil refineries in the United States except by an almost impossible manual review of each permit whenever they are filed in State or EPA regional offices.

    If there is to be refinement of the technology based effluent limitations through attention to water quality impacts, there must be an adequate data base for the transition and one does not presently exist.

11. My reference was to an evaluation of EPA's research performance by a body of scientists independent of reliance upon EPA funded research. Such a body might consist of distinguished (and perhaps retired!) professors from nationally outstanding universities, senior diplomates of the American Academy of Environmental Engineer's, long-term members of the National Academies of Science and Engineering, distinguished State officials or former officials responsible for

administering environmental programs and outstanding directors of private research institutions not directly involved in EPA funded research.

As to the criteria for evaluating EPA's research performance, the Agency could be asked to provide the Blue Ribbion Panel with the full details of five or ten research projects that have been undertaken internally or extramurally during the last five or ten years which it believes represents the highest quality of scientific effort of which the Agency is capable. The Panel would also be provided already available documents, submitted with budget requests or to Congressional Committees, that outline the Agency's past research accomplishments and future research goals. Additional information could be requested by the Panel, but special demands or reports should be kept to a minimum. Anyone who wished to do so should be allowed to furnish research views to the panel. The objective should be to determine the scientific relevance and adequacy of the EPA's research efforts.

The Panel's report should be made available to the EPA for any response it might wish to make and should also be furnished to the Congress and the President. Subsequent reviews should occur at appropriate intervals as policy makers might determine.

QUESTIONS FOR DR. GERARD ROHLICH

1. In your opinion, is a change to greater reliance on water quality based standards as the primary method of enforcing water pollution control prudent? What reasons or examples can you give to support your answer?

2. Your testimony has mentioned that we need to improve our ability to analyze and test for water pollutants, particularly toxic substances. In what specific areas of this do we need to especially focus our efforts?

3. Industries have performed some studies on the ability of Best Practical Treatment (BPT) to remove toxic metals and chemicals and have found it to remove substantial percentages of these materials. These groups have argued that these studies show that BAT requirements are unnecessary in some cases. Do you feel this is justified? What additional work needs to be done in this area? Are waivers from BAT requirements warranted in some cases?

4. Industrial and municipal groups also argued that categorical pretreatment standards are not necessary, claiming that secondary treatment by publicly owned treatment works (POTWs) removes enough of toxic metals and chemicals. Do you share this view? What reasons and examples can you give to support your answer?

Question 1

In your opinion is a change to greater reliance on water quality based standards as the primary method of enforcing water pollution control prudent? What reasons or examples can you give to support your answer?

Response

The effectiveness of a water quality control program is reflected in improvements in ambient quality, which is determined by an adequate monitoring program. The Clean Water Act incorporates both ambient water quality standards and effluent limitations and standards. The water quality standards can be considered as the objective and the effluent limitations as the means. It isn't a matter of greater reliance on one or the other. Successful implementation of a water quality management program depends on conjunctive use of both the technology based effluent limitations and water quality standards. Both should have a strong scientific base. Effluent limitations without ambient standards suggests certainty about the effects of the effluents on the environment. Ambient standards without effluent standards leads to difficulty and delay in enforcement.

Question 2

Your testimony has mentioned that we need to improve our ability to analyze and test for water pollutants, particularly toxic substances. In what specific areas of this do we need to especially focus our efforts?

Response

Ten years ago the Committee on Water Quality Criteria of the National Academies of Science and Engineering (NAS/NAE) compiled and published "Research Needs in Water Quality Criteria, 1972". Many of the specific research needs remain. In considering undesirable chemical and biological constituents in water recommendations for control must be based on knowledge of

(a) the pattern of distribution in the environment;

(b) physical, chemical, and biological mechanisms of transport through the environment;

(c) the nature and level of all acute, chronic, or cumulative effects on human well-being, particularly on sensitive segments of the population;

(d) degree of exposure;

(e) extent and accuracy of current analytical capabilities for monitoring purposes, and;

(f) adequacy of existing treatment technology for controlling aqueous concentrations of the constituent.

A great deal of research is needed in each of the areas listed above. Additional information is needed on:

Specific physiological effects on humans caused by low concentrations of heavy metals and organic compounds in water;

Mechanisms by which organic materials may chelate, stabilize, and transport toxic heavy metals in the environment;

Improved methods for removal of heavy metals and organics;

Dispersion and exchange processes in ground water systems;

Analysis and response of ecosystems to various pollutants including establishing methodologies and guidelines for determining assimilative capacities of receiving systems;

Synergistic and antagonistic effects of combinations of toxic materials;

Development of more rapid and more effective bioassay methods.

Question 3

Industries have performed some studies on the ability of Best Practical Treatment (BPT) to remove toxic metals and chemicals and have found it to remove substantial percentages of these materials. These groups have argued that these studies show that BAT requirements are unnecessary in some cases. Do you feel this is justified? What additional work needs to be done in this area? Are waivers from BAT requirements warranted in some cases?

Response

Waivers from BAT requirements may be warranted in some cases depending on the local situation. Regulations should have sufficient flexibility to permit a discharger to obtain a variance when it can be shown that relaxation of the regulation will not result in failure to maintain water quality standards. Unique local situations that take in account discharge characteristics relative to receiving water flows and quality may indicate that BPT is adequate.

Question 4

Industrial and municipal groups also argued that categorical pretreatment standards are not necessary, claiming that secondary treatment by publicly owned treatment works (POTWs) removes enough of toxic metals and chemicals. Do you share this view? What reasons and examples can you give to support your answer?

Response

Those responsible for the design, operation, and maintenance of publicly owned treatment works (POTWs) must, and generally do, recognize and take into account the impact of industrial wastes on collection systems and treatment facilities if they expect satisfactory performance by the facilities. The broad claim that "secondary treatment by POTWs removes enough of toxic metals and chemicals" cannot be supported. In some locations it is possible that secondary treatment may be adequate in reducing toxic metals and chemicals to acceptable levels. This depends on a number of factors including proportion of municipal flow contributed by industry, types of industries contributing and quantitative data on pollutants discharged to the municipal system as well as the type of secondary treatment facilities. Categorical pretreatment standards for the 34 consent degree industries should be developed, but provision should be made for waivers when the POTW in developing a pretreatment program can provide evidence that the volume and characteristics of an industrial discharge will not adversely affect collection and treatment facilities. An essential element in pretreatment programs is the development of an adequate and effective monitoring program for compliance and enforcement purposes.

Questions for Dr. Raymond C. Loehr

1. You have stated that nonpoint sources account for approximately 50% of this nation's total water pollution. What effect will Federal funding cuts and terminations in nonpoint pollution abatement programs have on the long-term water quality of the United States? Are nonpoint source pollution problems expected to increase or decrease in the next 5-10 years?

2. Your testimony has emphasized that we know very little about the contribution of nonpoint sources to the toxic chemical contamination of water. What specific types of research do we need to perform in order to begin to understand this relationship?

3. According to your testimony the effects of both point and nonpoint sources must be considered in a coherent quantitative manner. How will this be achieved in a rational and cost effective way given that resources and funding are presently constrained and the lack of understanding of the nonpoint pollution problem?

4. One of EPA's proposed amendments to the Clean Water Act is to redefine dams as being nonpoint sources of pollution and, therefore, subject to less regulation. Do you consider this amendment justified? Why or why not?

5. EPA has no specific authority to regulate pollution directly from nonpoint sources, but Section 208 of the Clean Water Act does provide for state and areawide comprehensive plans to identify all point and nonpoint pollution sources and recommend abatement measures. Federal funding for the 208 program was eliminated in FY 1982. What is your opinion of the effectiveness of this program? Should it be refunded? Why or why not?

6. The sewage sludge disposal problems of large cities are immense. You have mentioned that there is no hope in reducing to zero the risks involved in disposal of sewage sludge on ground and surface water. Do you feel that EPA's specific research program (municipal wastewater) in the area of risk assessment is adequate?

7. Your testimony suggests many research areas such as detoxification studies of sewage sludge and the movement and fate of sludge constituents (metals, toxic chemicals, and pathogens) that are applied in landfills. Do you believe that land application of sewage sludge containing toxic chemicals and metals to be the most cost-effective and environmentally safe disposal method at the present time?

RESPONSE TO WRITTEN QUESTIONS TRANSMITTED WITH THE JUNE 24, 1982, LETTER OF REPRESENTATIVE J.H. SCHEUER

1. Q. You have stated that non-point sources account for approximately 50% of this nation's total water pollution. What effect will Federal funding cuts and terminations in non-point pollution abatement programs have on the long-term water quality of the United States? Are non-point source pollution problems expected to increase or decrease in the next 5-10 years?

   A. This question was asked at the hearing on June 8 and an answer provided at that time. No further response or elaboration is needed.

2. Q. Your testimony has emphasized that we know very little about the contribution of non-point sources to the toxic chemical contamination of water. What specific types of research do we need to perform in order to begin to understand this relationship?

   A. Several types of research and monitoring should be undertaken. The efforts of the EPA Nationwide Urban Runoff Program should be continued, especially the monitoring of inorganic and organic priority pollutants in urban runoff. Such monitoring should continue until a definitive pattern emerges that identifies the contribution - in both time and quantity - of toxic chemicals to the nation's waters by urban runoff.

   Rural non-point sources are being sampled in state monitoring programs, in rural clean water projects, and as part of specific research and management efforts. Arrangements should be made to have such samples analyzed for inorganic and organic priority pollutants. At present, no data on the concentrations of synthetic organic chemicals, with the exception of some pesticides contributed by rural non-point sources, are being routinely obtained.

   These initial, continuing efforts would avoid major new initiatives at this time and should be integrated with existing efforts to obtain a broader perspective on the contribution of toxic pollutants by non-point sources. In a related manner, existing atmospheric deposition monitoring programs should be expanded to include analyses of toxic pollutants in collected samples.

With broader information available on the concentration of toxic pollutants in non-point sources actual loads can be determined and their impact assessed, frequencies of occurrence can be determined and the contribution of various sources can be better understood. If the impacts, either nationally or regionally, appear to be significant, research can be initiated to identify preventive measures and management practices that can reduce the impacts.

3. Q. According to your testimony, the effects of both point and non-point sources must be considered in a coherent quantitative manner. How will this be achieved in a rational and cost effective way given that resources and funding are presently constrained and the lack of understanding of the non-point pollution problem?

A. One of the current constraints to considering non-point sources in a coherent quantitative manner is the perspective by many that non-point sources are not an important water quality problem. As noted in my prepared testimony, non-point sources can contribute potentially large amounts of conventional and toxic pollutants to the nation's waters and should not be ignored. It will not be cost effective to make water quality management decisions related to toxic pollutants based on only point source information and later find out that non-point sources may have the larger impact.

An intial approach to considering non-point sources in a coherent manner was indicated in the response to question 2: (a) maintain a monitoring program to acquire information on the concentrations of priority pollutants in non-point sources, (b) where possible integrate such a program with on-going sampling efforts of state, federal or research organizations, and (c) assess the acquired data to identify the potential impact of the non-point sources.

4. Q. One of EPA's proposed amendments to the Clean Water Act is to redefine dams as being non-point sources of pollution and, therefore, subject to less regulation. Do you consider this amendment justified? Why or why not?

A. I have not kept abreast of the logic of this redefinition and am unable to provide any comment.

5. Q. EPA has no specific authority to regulate pollution directly from non-point sources, but Section 208 of the Clean Water Act does provide for state and area-wide comprehensive plans to identify all point and non-point pollution sources and recommend abatement measures. Federal funding for the 208 programs was eliminated in FY 1982. What is your opinion of the effectiveness of this program? Should it be refunded? Why or why not?

A. The effectiveness of the 208 program must be viewed in the perspective of what was attempted and the learning curve of the state and Federal personnel who were involved. The basic concept of Section 208 was and continues to be sound. It is appropriate to identify point and non-point sources of pollution and to plan for their control in a comprehensive manner.

Both within EPA and the states, 208 programs were handled largely by environmental engineers and planners who were more familiar with point sources and point source controls. In addition, many individuals in the agricultural sector initially looked upon the 208 efforts as a bother and another intrusion by the Federal government. Some individuals even considered 208 as a possible back door approach to land use controls. In addition, many of the 208 contractors were not very experienced with rural non-point sources in the beginning of the 208 program.

The Soil Conservation Service and other components of the U.S. Department of Agriculture did work closely with EPA and the states as did many land grant universities. These cooperative efforts continue and are a positive output of the 208 program.

Because of the lack of enthusiasm for the program in the agricultural sector and because of the increased knowledge about technical and institutional matters that had to be acquired by many agency personnel, the 208 program did not live up to its original hopes. However, in hindsight, the program probably was as effective as could be expected, given the conditions described above.

Prior to any consideration of re-initiating the 208 program, there shou .. be a critical analysis of what was done, how it was done, how the results were incorporated into planning efforts, and the type of institutional cooperation that was involved. With this forward-oriented review, the proper type and direction of a 208-type program that may be needed could be identified and the relative merits of refunding such a program clearly evaluated. At this time, it is not possible to make a flat statement that the program should or should not be refunded.

6. Q. The sewage sludge disposal problems of large cities are immense. You have mentioned that there is no hope in reducing to zero the risks involved in disposal of sewage sludge on ground and surface water. Do you feel that EPA's specific research program (municipal wastewater) in the area of risk assessment is adequate?

A. Risk assessment decisions are a function of the concentration of a chemical in the environment and the exposure of a human, animal, or plant to those concentrations. Thus, information on the frequency and concentration of toxic compounds in sewage sludge and the exposure that results from various sludge treatment and disposal options is needed to identify relative risks. EPA research efforts are acquiring information on the frequency and concentration of toxic chemicals in sludge and in effluent wastewaters. The acquisition of such information should continue.

Assuming that adequate funds are available, a particularly useful area of risk assessment research that should be undertaken relates to the exposure that the public receives from toxic pollutants in wastewater discharges and from sludge treatment and disposal options.

The adequacy of the EPA risk assessment research program is, in large measure, a function of the dollars available to support the program. Because of a reduction in the EPA research budget, the support and thus the adequacy of the program is weak.

7. Q. Your testimony suggests that many research areas such as detoxification studies of sewage sludge and the movement and fate of sludge constituents (metals, toxic chemicals, and pathogens) that are applied in landfills need investigation. Do you believe that land applicaion of sewage sludge containing toxic chemicals and metals to be the most cost-effective and environmentally safe disposal method at the present time?

A. Land application of sewage sludge can be an environmentally sound and cost-effective disposal method for many communities. The important question is not whether the sludges contain toxic chemicals, but whether these chemicals get into the food chain or ground water in concentrations that will harm the public if the sludges are applied to land.

The recommended rates of sludge application to land that have been developed by EPA and non-EPA supported research appear to be sound and to avoid the transmittal of toxic chemicals to the public. These rates are based upon the assimilative capacity of the soil to degrade, adsorb, or complex metals and organics. These rates are low when the sludge is applied to land that can be used for food chain crops and are in the range of 5 to 15 dry tons of sludge per acre.

Where sludge contains very high concentrations of toxic chemicals, disposal methods other than land application are preferable.

Questions for Mr. Russell H. Langford

1. Your testimony states that the National Stream Quality Accounting (NASQAN) monitoring Network is designed to answer the questions "What is the quality of water in the major river systems of the United States?" and "Is the quality changing?". Since the network has been in place long enough for trend analysis, what are your answers to these questions as they related to conventional and toxic pollutants?

2. A recent report by the General Accounting Office has stated that the monitoring networks used by the Environmental Protection Agency and the Geological Survey are insufficient and unreliable. The report states that these networks are not providing meaningful data for water quality assessments and recommends that EPA and the Geological Survey terminate their present networks and shift their resources to special studies of individual river areas. What is your opinion of these findings? To what extent does the Geological Survey use these special studies in assessing national water quality?

3. The lack of an adequate understanding of toxic substances in surface water is well know. What additional types of monitoring and research do you feel are necessary to enable us to adequately determine the status of toxic chemical contamination of our nation's surface water?

4. How many of the toxic "Priority Pollutants" are presently being analyzed in surface and groundwater samples?

5. The USGS estimates that less than 1 percent of the total usable groundwater has been contaminated. What specific pollutants are responsible for this contamination? Is the percentage of contaminated groundwater increasing or decreasing?

6. There is a definite need for improve understanding of geologic and hydrologic processes that control the behavior and fate of contamination in groundwater. What specific research has the Geological Survey undertaken in this regard and what are the results?

7. When will USGS have their report on the Wood River Nuclear Plant completed? Please provide any preliminary information from the report that you may have at this time.

8. Does USGS participate in or conduct research related to urban runoff? If so, where is this work being conducted and what federal agencies are also involved?

9. This Committee is aware of USGS' projects and activities on Long Island, New York dealing with the groundwater contamination problem that exists there. Please provide answers to the following questions as they relate to both the Nassau-Suffolk and the Brooklyn-Queens aquifer systems:

   o What is the USGS's opinion of the quality of the groundwater on Long Island?

- What activities (past, present, and ongoing) is USGS involved in that relate to the groundwater contamination problem of Long Island?
- How are USGS's activities distinguishable from other Federal, State, and local projects and activities?

10. You mentioned during your oral testimony that USGS has monitoring data (concentration levels and trends) for 35 water quality parameters over the last several years for many of our nation's rivers. Please provide for the record this information and any other relevant water quality data for the follow bodies of water: (1) Hudson River, (2) Jamaica Bay area of Hudson River and, (3) the Potomac River. We would also appreciate any information you could provide on the PCB contamination problem of the Hudson River.

Question 1

Your testimony states that the National Stream Quality Accounting (NASQAN) monitoring Network is designed to answer the questions "What is the quality of water in the major river systems of the United States?" and "Is the quality changing?". Since the network has been in place long enough for trend analysis, what are your answers to these questions as they related to conventional and toxic pollutants?

Response

Data gathered in the National Stream Quality Accounting Network (NASQAN) Program are just now becoming abundant enough to permit meaningful time-trend analyses. As indicated in the prepared testimony of June 8, 1982, a battery of statistical procedures have recently been applied to the NASQAN and Benchmark data bases, and a comprehensive statistical summary now in preparation should be available in published form before the end of 1982. The summary will focus on the status and trends in water quality at the 313 (of the total 504) NASQAN stations which have at least 5 years of data, and on all 52 Benchmark stations (average of 14 years of data). Information contained in the statistical summary will closely resemble that in the recently published study (copy enclosed) of phosphorus trends, which is described in some detail in the prepared testimony.

Examples of summary statistical tables for two NASQAN stations--the Hudson River at Green Island, NY, and the Potomac River at Chain Bridge, Washington, D.C.-are included in the response to question 10 of this package. The statistical summary soon to be published will include such tables for each of the 313 NASQAN and the 52 Benchmark stations. In addition, a national map will identify those sites where the applied statistical tests indicate upward trends, downward trends, and no significant change in the observed levels for each water-quality parameter.

Even when the statistical analyses and maps are completed, the answers to questions about national trends in water quality will remain fundamentally complex and will necessarily involve the reporting of a large amount of technical detail. In nearly all cases, the results of trend tests applied to data for a given water-quality parameter will show increases at some stations, decreases at others, and no significant trend at the remainder of the stations. In only certain cases will there be apparent regional and national patterns. These cases will be highlighted because identification of geographical patterns and general trends in water quality is the primary goal of the program. However, it appears unlikely that a general national improvement or deterioration in water quality will be found. Most likely, the goodness of water quality and the direction of discernable trends will vary both with location and for the specific water-quality parameters.

Question 2

A recent report by the General Accounting Office has stated that the monitoring networks used by the Environmental Protection Agency and the Geological Survey are insufficient and unreliable. The report states that these networks are not providing meaningful data for water quality assessments and recommends that EPA and the Geological Survey terminate their present networks and shift their resources to special studies of individual river areas. What is your opinion of these findings? To what extent does the Geological Survey use their special studies in assessing national water quality?

Response

The GAO report recommends the discontinuance of fixed-station water-quality monitoring including the USGS National Stream Quality Accounting Network NASQAN) and the Environmental Protection Agency networks. The GAO's primary argument is that water-quality phenomena are too complex and variable, in space and in time, to be adequately characterized by monthly samples collected at a widely scattered set of sampling locations (504 stations in NASQAN). The Geological Survey agrees that such data are not adequate for certain purposes such as planning waste treatment facilities or identifying specific source areas of hazardous wastes, but believes they are essential for observation of trends in water quality. The GAO further recommends that the NASQAN funding (about $4 million per year) be used for additional problem-oriented studies such as the Intensive River Quality Assessments that the Geological Survey has carried out over the past 10 years. The Geological Survey agrees with the GAO concerning the value of these studies and continues to include them as an important component of its program, but does not believe they should be expanded at the expense of network operations.

Our differences with the GAO are summarized as follows:

- Special problem-oriented water-quality studies are not an alternative for national networks, as the GAO suggests, but satisfy a separate complementary function. Both approaches to water quality appraisal are needed.

- To perform national comparisons one must have nationally consistent (time, place, kind and quality) data and this can only be feasibly obtained from national networks.

Much of the Survey's work in assessing water quality is based on special studies. These special studies stress development of a detailed understanding of hydrologic processes, with reference to a specific reach or section of a basin, and the use of that understanding to project the consequences of proposed water management alternatives. These studies are short term and problem specific and do not lend themselves to national assessments of water quality because they are not evenly distributed geographically or continuous in time. Thus, although special studies are a vital part of water-quality assessment they do not lend themselves to national summarizations.

The primary objective of NASQAN is to provide a nationwide overview of stream quality, from which geographic and temporal variability can be inferred. Only by regularly monitoring water quality and quantity and by measuring many chemical, physical, and biological characteristics of the water over all the seasons at a number of fixed sites, it is possible to infer how these water-quality characteristics vary with the seasons, with flow, and with other related characteristics. Then subsequent measurements can be viewed in this context and one can make statistically supportable statements that these measurements do, or do not, represent a change from the past. Because of this capability, fixed station, long-term networks provide a powerful means to identify regional and possible national changes in water quality and emerging water-quality problems.

Question 3

The lack of an adequate understanding of toxic substance in surface water is well known. What additional types of monitoring and research do you feel are necessary to enable us to adequately determine the status of toxic chemical contamination of our nation's surface water?

Response

A more comprehensive assessment of the status of toxic substances in surface waters would require a combination of increased research and increased monitoring.

Research would be helpful in the areas of both chemical analysis and sampling methods. Most toxic chemicals are important at concentrations that are low in relation to the analytical capabilities of our laboratories. For each chemical of interest, including new ones introduced every year, it is important to carefully evaluate the best analytical methods and document the precision attainable over the entire range of possible concentrations. Toxic substances exhibit a wide range of chemical characteristics, including variable water solubility and variable stability in different temperature and light conditions. Further investigation would be helpful on the effects of different sampling and sample preservation techniques on the integrity of samples collected for analysis of toxics.

Further research would be useful to understand the behavior of different toxic compounds in the environment, including their persistence, chemical transformations, and transport in relation to hydrologic factors. Without a better knowledge of these and other characteristics of toxic chemicals, it may be difficult to use monitoring data to help assess such factors as the causes of toxic contamination problems or the mass loading of toxic chemicals in a river. A better understanding of the environmental behavior of toxic substances can probably best be obtained from studies of several river reaches and basins representative of the different types of toxic contamination problems.

Monitoring should provide a consistent data base over time to permit comprehensive assessment of the overall distribution and extent of toxic contamination nationwide. Toxic chemicals present a difficult monitoring problem, however, because they are often difficult to detect, are very expensive to measure, occur in relation to use patterns which create patchy occurrences, have variable lifetimes in the hydrologic system, and because new chemicals are frequently brought into use while use of others is curtailed. Changing use patterns necessitate periodic re-examination of which chemicals should be monitored. For example, persistent chemicals, such as the DDT family, may need to be monitored long after use has stopped, whereas monitoring of chemicals that degrade quickly may be discontinued shortly after use is discontinued. The changing importance of different chemicals with time results in data records of variable lengths for different chemicals that often are of insufficient length for trend detection or certain other statistical analyses.

The present monitoring approach could be supplemented to include a wider range of toxic chemicals and could be altered to be made more responsive to changes in the importance and distribution of different chemicals. A framework of fixed station, fixed frequency sampling, such as is now in place, could be supplemented by periodic nationwide surveys that include more stations and use sampling techniques integrating large volumes of water at each station. Such periodic surveys could help provide detailed information on the distribution of chemicals that are not in use long enough to develop long-term data records and also could help in directing periodic revisions in the specific chemicals monitored. Finally, the previously mentioned research effort directed at detailed study of selected areas could also be considered an ongoing part of the monitoring program. Long-term records from these detailed studies could have important transfer value for similar basins and river reaches, and for interpreting other monitoring data.

The U.S. Geological Survey has strong programs in hydrologic data collection and analysis, and hydrologic research. These ongoing activities are designed to achieve many of the Nation's requirements for information on the presence of toxic substances in surface water.

Question 4

How many of the toxic "priority pollutants" are presently being analyzed in surface- and ground-water samples?

Response

A few years ago, a judicial ruling directed EPA to place priority attention on 129 compounds which posed a significant threat to the public from ingestion through water or other means. These compounds make up the Priority Pollutant List, all of which are known to be toxic at very low concentrations. Of the 129 elements or compounds, 13 are trace metals; one, asbestos, is a silicate mineral which occurs as individual microscopic fibers or conglomerates of fibers; and the remaining 115 are manmade organic compounds, except for cyanide which can occur naturally, but only in very small concentrations.

All of the compounds on the Priority Pollutant List can be analyzed by Federal, State, university, or commercial laboratories in the Nation but, normally, no single laboratory is equipped to determine all.

Of the 129 priority pollutants, Geological Survey laboratories have the capability for routine analysis of 125. The four compounds not determined by our laboratories include the following:

1. Asbestos--the identification and measurement of asbestos fibers in water require enormously expensive and sophisticated equipment, and methods for analysis are not widely agreed upon. Commercial or university laboratories will determine asbestos under contract.

2. 2, 3, 7, 8-tetrachloro dibenzo-p-dioxin (TCDD)--this compound is so toxic that handling the standard reagents needed for quantification presents a significant health hazard to laboratory personnel. Therefore, TCDD can be identified but not quantified in our laboratories. Specially equipped commercial or university laboratories will perform the analyses under contract.

3 & 4. Acrolein and acrilonitrile--both polymerize rapidly in water and are not detectable in their original forms.

Of the list of 125 priority pollutants measurable in USGS laboratories, most are performed only on special request from the District offices or from projects of the National Research Program. Only selected trace metals and pesticides are measured routinely in the national monitoring programs--the Hydrologic Bench-Mark Program, and the National Stream Quality Accounting Network (NASQAN). There are two reasons for the incomplete coverage of Priority Pollutant measurement at the national water quality monitoring sites: 1) cost--analyses for the priority pollutants cost about $1,000 per sample, and 2) occurrence--the majority of the priority pollutants commonly do not occur in river samples and when they do, are nearly always associated with a specific industrial discharge or contamination from a specific landfill.

Question 5

The USGS estimates that less than 1 percent of the total usable ground water has been contaminated. What specific pollutants are responsible for this contamination? Is the percentage of contaminated ground water increasing or decreasing?

Response

Virtually every kind of contaminant has been found in ground water, including trace metals, pesticides, radionuclides, virus, bacteria, and large varieties of other organic compounds. Among the most ubiquitous toxic contaminants are organic compounds in gasoline and fuel oil, such as polynuclear aromatic hydrocarbons and benzene, and chlorinated solvents such as trichloroethylene. The EPA lists septic tanks, petroleum production operations, and landfills and dumps as the most significant sources of ground-water contamination.

We do not have sufficient data to indicate directly that the percentage of contaminated ground water is increasing. However, based on increased generation rates of industrial and domestic waste products, population increases, and the apparent increasing frequency of contamination discovery, it is probable that ground-water contamination is increasing.

Question 6

There is a definite need for improved understanding of geologic and hydrologic processes that control the behavior and fate of contamination in ground water. What specific research has the Geological Survey undertaken in this regard and what are the results?

Response

The Geological Survey carries out a comprehensive and interdisciplinary research program to study the earth-science processes that affect the fate of contaminants in ground-water systems. Major areas of emphasis include the following:

1. Organic Hydrogeochemistry--Research is being performed to study the movement of organic materials through ground-water systems. Results of studies in Stanton, TX, designed to show how organic constituents react with aquifer materials, indicate that some classes of organic compounds move through the ground without much reaction, while others are adsorbed by the aquifer materials. Work is just beginning on the chemical mechanisms and rates of reaction of organic contaminants in ground waters.

2. Hydrobiologic Processes--Microbial processes can greatly affect the movement of organics through ground-water systems. Anaysis of samples collected from an aquifer contaminated by coal tar derivatives in St. Louis Park, MN, indicated that phenols decrease in concentration during travel through the aquifer at a faster rate than non-reactive constituents. Bacteria were found in the surface materials which convert the phenol to methane, accounting for its loss.

3. Ground-Water Modeling--Models are tools that help describe complex processes affecting the movement of ground water and dissolved constituents. While modeling theory is generally well established, many real-system complexities remain to be resolved.

Promising results were obtained this year using a new technique to study experimentally the principles of solute transport in unsaturated, low-water content soils. Significant progress is also being made in developing better techniques to measure aquifer properties needed as input to models.

A case study using a ground-water flow model of the Madison aquifer in the Powder River Basin of Wyoming and South Dakota shows that large-scale linear features on the land surface, discharge from large springs, and recharge from the Black Hills can significantly influence regional flow.

Laboratory studies are being conducted to test computer models for evaluating the movement of hazardous chemicals through certain types of fractured porous materials. Early results indicate the computer model is able to predict the movement of boron in a simulated fracture-flow system. In addition to our basic research program the Survey conducts a number of other site-specific and regional studies in cooperation with other Federal, State, and local agencies.

Question 7

When will the USGS have their report on the Wood River Nuclear Plant completed? Please provide any preliminary information from the report that you may have at this time.

Response

The USGS embarked on a study of the Wood River Junction, RI, contamination site about 1 year ago. The study is one component of a larger national research program on the fate and behavior of contaminants in ground water. Present plans call for completing the project in 2 more years at which time all significant results will be published. The first interim report will be released early in 1983. The objectives of the study are to determine the types of contaminants present and their areal and vertical extent; to determine three dimensional ground-water flow velocities and trajectories; and to develop a computer model which will simulate the flow and chemistry of the system for use in predicting the rate of flushing of contaminants into the Pawcatuck River. The study is focusing on two radioisotopes, strontium-90 and technetium-99, and on three non-radioactive contaminants, nitrate, potassium and boron. Significant findings after the first year of study include:

1. Technetium-99 appears to be the primary contribution to beta radioactivity in the water.

2. None of the currently identified waste radionuclides appears to strongly react chemically with the sedimentary material.

3. The zone of maximum contamination of some constituents such as nitrate in ground water extends beneath and beyond the Pawcatuck River.

4. A ground-surface geophysical technique using electromagnetic conductivity was found to be very useful in delineating the approximate areal extent of the contamination plume of elevated dissolved waste solutes.

Question 8

Does USGS participate in or conduct research related to urban runoff? If so, where is this work being conducted and what Federal agencies are also involved?

Response

The USGS conductes research in urban areas. This involves studies of the effects of urbanization on flood frequency and magnitudes; flow characteristics; the sources, types, and loads of chemical constituents from urban areas; processes of transport of these constituents; effects of urban runoff on receiving waters; and an evaluation of selected best management practices for moderating the effects of urban runoff on downstream water bodies.

The enclosure lists the various locations of urban research conducted by the U.S. Geological Survey. In many of these locations, there may be several separately funded projects.

In addition to location, the enclosed list shows the primary emphasis of the research and other Federal agency involvement. Other Federal agencies such as the Environmental Protection Agency and the Federal Highway Administration have considerable interest in many of the USGS research studies and are involved with USGS in the planning of the studies. The last column of the table identifies those locations where the USGS receives funding directly from other Federal agencies.

URBAN RUNOFF RELATED STUDIES IN THE USGS

PROJECT LOCATION	URBAN RUNOFF QUANTITY STUDIES (a)	URBAN RUNOFF PROBLEM ASSESSMENT (b)	IMPACTS OF URBAN RUNOFF ON RECEIVING WATERS (c)	ASSESSMENT OF BEST MANAGEMENT PRACTICES	OTHER	OTHER FEDERAL AGENCY INVOLVEMENT
Alaska:						
Anchorage	-	X	X	-	-	None
Arizona:						
Tucson	X	-	-	-	-	None
California:						
Fresno	-	X	-	X	-	None
Colorado:						
Denver	X	X	X	X	X(d)	None
Denver Federal Center	X	-	-	-	-	General Services Administration
Connecticut:						
Statewide	X	-	-	-	-	None
Florida:						
Jacksonville	X	-	-	X(e)	-	None
Miami	-	X	X	-	-	None
Orlando	-	-	X	X(e)	-	None
Tallahassee (Leon Co.)	X	X	-	-	-	None
Georgia:						
Atlanta	X	-	-	-	-	Corps of Engineers
Statewide	X	-	-	-	-	None
Iowa:						
Bettendorf	X(f)	-	-	-	-	Corps of Engineers
West Des Moines	X(f)	-	-	-	-	None

URBAN RUNOFF RELATED STUDIES IN THE USGS

PROJECT LOCATION	URBAN RUNOFF QUANTITY STUDIES (a)	URBAN RUNOFF PROBLEM ASSESSMENT (b)	IMPACTS OF URBAN RUNOFF ON RECEIVING WATERS (c)	ASSESSMENT OF BEST MANAGEMENT PRACTICES	OTHER	OTHER FEDERAL AGENCY INVOLVEMENT
Kansas:						
Topeka	-	X	X	-	-	None
Wichita	X	-	-	-	-	None
Maryland:						
Baltimore	-	X	X	-	-	None
Minnesota:						
Minneapolis/St. Paul	-	X	X	X	-	None
Missouri:						
Kansas City	-	X	X	-	-	None
St. Louis	X	-	-	-	-	None
Nevada:						
Lake Tahoe	-	X	-	-	-	None
New Jersey:						
Camden and areas east	-	-	X(g)	-	-	None
Somerset County	X	-	-	-	-	None
New Mexico:						
Albuquerque	X	X	-	-	-	None
New York:						
Long Island:	-	X	X	X	-	None
Kings/Queens Counties	-	-	X	-	-	None
Nassau County	-	-	X	-	X(h)	None
Rockland County	X	-	-	-	-	None
Rochester	-	X	X	X	-	None
Statewide	X	-	-	-	-	None

URBAN RUNOFF RELATED STUDIES IN THE USGS

PROJECT LOCATION	URBAN RUNOFF QUANTITY STUDIES (a)	URBAN RUNOFF PROBLEM ASSESSMENT (b)	IMPACTS OF URBAN RUNOFF ON RECEIVING WATERS (c)	ASSESSMENT OF BEST MANAGEMENT PRACTICES	OTHER	OTHER FEDERAL AGENCY INVOLVEMENT
North Carolina:						
Coastal Plains	X	-	-	-	-	None
Durham	X	X	X	X	-	Federal Highway Administration
Ohio:						
Akron/Cleveland	-	-	X	-	-	National Park Servi
Statewide	X	-	-	-	-	None
Oregon:						
Portland	-	-	-	-	X(1)	None
Roseburg	X	-	-	-	-	None
Salem	X	X	X	X	-	None
South Dakota:						
Rapid City	-	X	X	-	-	None
Tennessee:						
Memphis/Shelby Counties	X	-	-	-	-	None
Statewide	X	-	-	-	-	None
Texas:						
Austin	X	X	X	X	-	None
Houston	X	X	-	-	-	None
San Antonio	X	X	-	-	-	None
Utah:						
Salt Lake City	-	-	X	-	-	None
Salt Lake County	-	X	-	X	-	None
Washington:						
Bellevue	-	X	-	X	-	None

URBAN RUNOFF RELATED STUDIES IN THE USGS

PROJECT LOCATION	URBAN RUNOFF QUANTITY STUDIES (a)	URBAN RUNOFF PROBLEM ASSESSMENT (b)	IMPACTS OF URBAN RUNOFF ON RECEIVIN WATERS (c)	ASSESSMENT OF BEST MANAGEMENT PRACTICES	OTHER	OTHER FEDERAL AGENCY INVOLVEMENT
Wisconsin:						
Green Bay	-	X	-	-	-	None
Madison	X	X	-	-	X(j)	None
Middleton	X	-	-	-	-	None
Milwaukee	X	X	-	X	-	None
Milwaukee Harbor	-	X	X	-	-	None
Statewide	X	-	-	-	-	None

(a) Includes studies of the effects of urbanization on peak flows, their magnitude and frequency, and on runoff volumes and other flow characteristics.

(b) Includes identifying types of constituents, including sediment, in runoff from various urban sources and the magnitude of constituent loads.

(c) Includes streams, lakes, and ground water.

(d) Waste-load assimilation study on the South Platte River as related to dissolved oxygen.

(e) Assimilation capacity study of detention ponds.

(f) Model simulation studies of rainfall/runoff processes in an urban area.

(g) Study of relations of ground-water contamination related to various land uses.

(h) Evaluation of factors causing clogging of ground-water recharge basins.

(i) Study of fall velocities of sediment-related constituents in native waters.

(j) Evaluation of effects of land uses on flow, sediment transport, and on channel geometry.

Question 9

This Committee is aware of USGS' projects and activities on Long Island, New York dealing with the ground-water contamination problem that exists there. Please provide answers to the following questions as they relate to both the Nassau-Suffolk and the Brooklyn-Queens aquifer systems:

- What is the USGS' opinion of the quality of the ground water on Long Island?
- What activities (past, present, and ongoing) is USGS involved in that relate to the ground-water contamination problem of Long Island?
- How are USGS's activities distinguishable from other Federal, State, and local projects and activities?

Response

Under predevelopment conditions, the quality of almost all of Long Island's fresh ground water was excellent. Today, a vast amount of high-quality water remains in the ground-water reservoir; however, the quality of the resource has been adversely affected by man's activities. Documented sources of ground-water contamination include cesspools and septic tanks, leaks from muncipal sewerage systems, industrial waste disposal, municipal landfills, underground gasoline- and oil-storage tanks, road-salting activities, and the use of fertilizers and pesticides. Furthermore, hydrologic imbalances caused by excessive pumping for public water supply have induced localized saltwater encroachment into parts of the ground-water reservoir.

Because ground-water quality is affected by population density, land use, and hydrogeologic factors, ~~there are~~ significant differences in quality in different areas of the ground-water reservoir. In general, ground-water quality improves with depth, because many chemical contaminants enter the ground-water system at or near land surface. As a result, the upper glacial aquifer, the topmost of the three major aquifers, has been most seriously affected by contamination from surface sources. In contrast, the Lloyd aquifer, the deepest aquifer, is virtually unaffected by surface contamination because it is overlain and protected by a confining clay (Raritan clay). However, saltwater encroachment is a serious threat to water quality in the Lloyd aquifer. This is especially true under the barrier islands along the south shore where the Lloyd aquifer not only has a seaward saltwater front, but is also subject to slow vertical movement of saltwater from the overlying Magothy aquifer.

Long Island ground-water quality also reflects the easterly migration of population that has taken place on the island since the mid-19th century. At present, different parts of Long Island are characterized by different stages of ground-water development and the associated water-quality problems. In western Long Island (Kings and western Queens Counties), population growth generated rapid ground-water development in the 19th century. Rapid increases in population and the attendant increase in pumping of ground water for industry and public supply, in addition to numerous other affects of urbanization, resulted in severe water level declines and saltwater intrusion. As a result, pumping for public supply in Kings County was stopped in 1947. In parts of Queens County, pumpage for public supply has continued, but the trend in pumping has been to abandon wells showing contamination and to install new ones eastward, farther from the shores, and near higher water levels in the center of the island.

Eastern Queens and western Nassau Counties became highly urbanized from the mid-1940's to the 50's. At present, the shallow upper glacial aquifer in this area has been extensively contaminated from sources at or near the land surface, such as cesspools and industrial waste-disposal sites. Most of the water supply in this area is derived from deep wells tapping the Magothy aquifer, Jameco Gravel, and the Lloyd aquifer. Because most of this area has now been sewered with an attendent decline of ground-water levels, there is a high potential for local saltwater intrusion into the aquifers.

Eastern Nassau and western Suffolk Counties experienced rapid population growth from the 1950's to the 1970's and large parts of the area are being sewered. Saltwater encroachment has not yet occurred, but pumping stress and sewerage is causing an imbalance in the ground-water system.

Eastern Suffolk County, including the North and South Forks, is experiencing population growth, which has resulted in higher ground-water demands in a sensitively balanced freshwater/saltwater system. Some ground water has been contaminated by pesticides used in agriculture.

As indicated by this brief summary, a great deal is known about Long Island's water resources. This is the result of the cooperative efforts of local, State, and Federal agencies. The Geological Survey has been involved in virtually all of these efforts. The Survey's role in these continuing studies has been (1) to provide technical expertise; (2) to maintain a viewpoint of understanding the occurrence and movement of ground water in the entire system rather than in a specific town or other social/political entity; and (3) to provide hydrologic data that have been collected continuously since the early 1900's. Unlike most other State, local, and Federal agencies on Long Island, the Survey does not have regulatory or enforcement responsibilities; it neither sets standards nor manages the ground-water resources of Long Island. Instead, USGS collects and interprets data to continually improve the understanding of Long Island's hydrologic system. The Survey conducts its work in cooperation with the agencies that manage Long Island's water resources and aids these agencies in evaluating the effects of various management alternatives on the hydrologic system.

The Geological Survey has been involved in a continuous series of water-resource studies on Long Island since the early 1900's. These studies, documented in over 300 scientific and technical papers, provide the basis for our present understanding of Long Island's hydrologic system. A partial list of past projects includes geologic and hydrologic investigations designed to assess the extent of the resource; studies of water quality in areas affected by man's activities; use of ground-water modeling techniques to predict the hydrologic effects of stresses on the system; and studies of the hydrologic and water-quality effects of artificial recharge with stormwater and highly treated sewage effluent. At present, the USGS is involved in the following cooperative studies:

1. Ground-Water Resources in Western Long Island

Urbanization and severe overpumping in western Long Island have caused the cessation of all pumping for public supply in Kings and western Queens Counties. At present, water supply in Kings and Queens Counties depends on nearly 700 million gallons per day of water that is imported from upstate New York surface-water sources. During recent periods of severe drought, this supply was unreliable.

This problem could be alleviated by expanded use of ground water. The objective of the study is to determine whether the ground-water reservoir under western Long Island is still a useable source of water supply and, if so, to make pertinent scientific information available for the formulation of a management plan for its development. Two basic questions are being addressed: whether the ground-water quality is suitable for use as a supplement to the public supply, and what quantity of water can be withdrawn without inducing saltwater intrusion?

2. Artificial Recharge on Long Island

The hydrologic and water-quality effects of artificial recharge with reclaimed water are being investigated. The study evaluates factors controlling improvement or degradation of water quality after recharge, and the hydraulic response of the aquifer system. From these findings, the optimum recharge procedures and costs may be evaluated and the impact of large-scale recharge with reclaimed water on the Long Island ground-water system will be assessed.

3. Organic Chemicals in Ground Water

Organic chemicals in ground water are a significant problem in Long Island. Chemicals found to date include both halogenated and non-halogenated organic chemicals. Sources of these chemicals include cesspool and drain cleaners, industrial solvents, landfill leachate, gasoline leakage from storage tanks, and pesticides and herbicides used in agriculture. The objectives of the organic chemical investigation are: 1) define the causes of the observed temporal fluctuations in concentrations and uneven distribution of organic chemicals in ground water and 2) investigate the movement of organic chemicals through both the unsaturated and saturated zones.

4. Effects of Urban Runoff on Ground Water

Runoff from precipitation on Long Island is routed to numerous recharge basins on the island. Although this water is filtered through the soil zone, pollutants from this source may reach the ground-water system. The objectives of the study are: 1) define the type, quantity, and fate of pollutants in runoff to basins, 2) evaluate the changes in runoff that may result from various management practices and, 3) determine changes in water quality as runoff moves through the unsaturated zone.

5. Geohydrology of the Pine Barrens Area, Suffolk County, New York

The Pine Barrens is an area proposed to be a source of high-quality ground water on Long Island. Because this is one of the least populated and least industrialized areas on the island, its ground water is probably of high quality. The objectives of the study are 1) evaluation of background and altered water-quality conditions in the aquifers, 2) definition of the geohydrology of the area, 3) evaluation of the relationship between surface-water bodies and the ground-water reservoir, 4) determination of the location of the fresh-water/saline-water interface in the aquifers, and 5) evaluation of potential water-management schemes using a regional three-dimensional ground-water flow model.

6. Ground-Water Contamination by Landfill Leachate

A study of a lined landfill in the Town of Brookhaven addresses the direction of movement, magnitude, and impact of the leachate plume that would result if no liner were present or if leaks should develop. The objectives of the study are to 1) determine the optimum location and depth for observation wells needed to locate plumes of leachate, and 2) develop a predictive solute-transport model for the site under investigation.

7. Ground-Water Contamination by Aldicarb

A highly toxic pesticide, aldicarb, was introduced on Long Island in 1975. In August 1979, this pesticide and some of its toxic breakdown products were detected in the shallow ground water of eastern Suffolk County. The objectives of this study are to: 1) define areas where ground-water contamination by this pesticide has occurred, 2) determine areas of pesticide application and detect any relationship to ground-water flow and recharge patterns, and 3) delineate any areas that do not seem to be readily susceptible to contamination.

8. Investigation of Freshwater/Saline-Water Interface Under Montauk Area, Long Island

The Montauk study addresses an area where the sole source of freshwater occurs in direct contact with tidewater at the shores. The ground-water system contains several relatively thin, lenticular "bubbles" of fresh ground water that "float" on top of saline water. During periods of heavy ground-water pumping in the village of Montauk, operation of public-supply wells must be staggered to reduce the upward movement of saline water. The objectives of the investigation are: 1) define the size and configuration of freshwater lenses, 2) investigate the response of these lenses to natural fluctuations in precipitation and to the seasonal pumping stress, and 3) determine their probable response to proposed schemes for future development of the ground water.

9. Computer Simulation of the Long Island Ground-Water Flow System

Understanding of both natural and man-induced stresses on the hydrologic system is improved by ground-water modeling techniques. The objectives of the study are: 1) provide quantitative estimates of physical changes in the ground-water sys em, 2) estimate the effects that stresses within the ground-water system would have on the quantity and quality of surface water, 3) determine rates and direction of ground-water flow under natural and stressed conditions, and 4) to use this information to predict changes in water quality resulting from movement of pollutants and natural contaminants.

Much of the information obtained from hydrologic studies on Long Island is ultimately uncorporated into digital models. For example, information from the study of the ground-water resources in western Long Island and in the Pine Barrens area will be used to update the regional model. Information collected in the area of the landfill in the Town of Brookhaven and in the Montauk area will be incorporated into more site-specific models.

Question 10

You mentioned during your oral testimony that USGS has monitoring data (concentration levels and trends) for 35 water-quality parameters over the last several years for many of our Nation's rivers. Please provide for the record this information and any other relevant water-quality data for the following bodies of water: (1) Hudson River, (2) Jamaica Bay area of Hudson River, and (3) the Potomac River. We would also appreciate any information you could provide on the PCB contamination problem of the Hudson River.

Response

The Geological Survey has not conducted hydrologic studies specifically on Jamaica Bay and, therefore, cannot provide information on the Jamaica Bay area of the Hudson River.

The following information on water quality of the Hudson and Potomac Rivers is provided in three sections. The first section provides and explains statistical analyses for trend detection for 38 water-quality parameters each at the Geological Survey NASQAN stations on the Hudson and Potomac Rivers. The second section describes the PCB contamination problem of the Hudson River as determined from cooperative studies of the New York District Office. The third section describes the general water quality of the tidal Potomac River as determined from the Survey's Potomac Estuary Study.

Summary of National Stream Quality Accounting Network (NASQAN) Hudson and Potomac Rivers

Tables A and B are summary tables which present the results of a battery of statistical procedures applied to the data collected at NASQAN stations on the Hudson and Potomac Rivers for the years 1973 through 1981. The tables provide for each of the 38 chemical and biological parameters, the averages of concentration and the mass transport. Also listed are the Seasonal Kendall Slope estimates for concentration, transport, and flow-adjusted concentration. These statistical parameters are explained in Geological Survey Water-Supply Paper 2190--"A Study of Trends in Total Phosphorus Measurements at NASQAN Stations" (copy enclosed). The slope values in Tables A and B are given in percentage terms for ease of comparison. That is "trend percent per year" means the slope of the regression line in milligrams per liter (or tons per day) per year divided by the average value in milligrams per liter (or tons per day) and multiplied by 100. The units in all cases are percent (of average) per year. Trends that are statistically significant at the 5 percent level are marked with an "S" and those at the 1 percent level by an "HS" corresponding to "significant" and "highly significant."

Also shown is the square of the correlation coefficient ("r squared") obtained in a regression against streamflow. This is also marked "significant" (S) or "highly significant" (HS). A positive or negative slope of the fitted flow-adjustment equation (concentration versus discharge) is indicated by a plus (+) or minus (-), respectively.

For the heavy metals, frequencies of exceedence of water quality standards (domestic water supply and aquatic life) are given except in cases where the laboratory detection limit for a parameter was higher than the standard. In the latter case, the detection limit (denoted DL) is used for comparison rather than the standard. Flow-adjusted trend values are not calculated for the heavy metals because of the difficulty of performing regressions against streamflow when concentration data include values recorded as "less than detection limit."

Table C compares the significant trend results from the summary tables for the Hudson and Potomac Rivers.

Both rivers show increasing concentrations of nitrate and certain common dissolved solids, especially chloride. The increases in nitrate probably reflect increasing use of nitrate fertilizers during the 1970's, not only in agriculture, but also in lawn fertilizers in the course of suburban development in the Hudson and Potomac basins. The increases in chloride and other dissolved solids probably reflect an increased use of road salt during winter storms in those basins.

The down trends in temperature in the Hudson and in turbidity and phytoplankton densities in the Potomac are interesting because, in theory at least, they represent improving water quality. The reasons for these changes are not readily apparent, however, and indicate the need to follow up the analysis of monitoring data with more intensive research in the basins. The decreases in phytoplankton densities and turbidity in the Potomac are not necessarily inconsistant with the increase in nitrate, a plant nutrient; they indicate, instead, the likelihood that nitrogen is not a limiting nutrient for phytoplankton growth in the river upstream of Washington, D.C.

Summary Statistics for the Hudson River NASQAN Station

Station ID	Station Location		
13580.00	HUDSON RIVER AT GREEN ISLAND NY	Mean Discharge (cfs) 16231	Drainage Area (sq mi) 8090

Beginning year of record 1972

Common Quality Constituents (sampled monthly)	N	Concentration (mg/l) MEAN	STANDARD DEVIATION	TREND (%/yr)	Flow Adjusted Concentration REGRESSION vs FLOW r squared	N	type	slope	TREND (%/yr)	Transport (metric tons/day) MEAN	TREND (%/yr)
Temperature (degrees C.)	98	12.9	8.8	1.0S	0.42HS	41	hyp	-	-5.2S		
pH (standard units)	99	7.3	0.5	-0.0	0.10	40	lin	-	-0.6	0.43E-05	-2.7
Alkalinity	89	48.2	10.8	1.0	0.12S	40	lin	-	-1.5	0.19E+04	-5.0
Sulfate	99	17.4	4.0	1.9S	0.44HS	40	log	-	4.8	0.63E+03	-4.5
Nitrate-Nitrite	75	0.56	0.16	2.7S	0.00	37	inv	-	2.7S	0.21E+02	-1.9
Kjeldahl Nitrogen	79	0.5	0.2	3.0	0.05	37	hyp	-	3.0	0.22E+02	-7.8
Total Organic Carbon	47	6.7	5.9	3.0	0.10	25	lin	+	3.0	0.27E+03	-15.2S
Phosphorus	96	0.06	0.04	-0.0	0.19HS	38	inv	-	-3.7	0.24E+01	-3.0
Calcium	86	21.1	4.1	1.7S	0.26HS	41	lin	-	-0.4	0.82E+03	-5.1
Magnesium	86	3.8	0.7	1.3S	0.19HS	41	lin	-	-2.1	0.15E+03	-5.4
Sodium	86	7.0	2.5	5.8HS	0.33HS	41	hyp	-	10.8HS	0.23E+03	1.6
Potassium	86	1.0	0.3	2.8HS	0.03	41	inv	-	2.8HS	0.40E+02	-3.3
Chloride	99	9.7	3.1	4.1HS	0.33HS	40	hyp	-	5.8HS	0.33E+03	-1.1
Silica	87	4.0	1.1	-1.2	0.49HS	39	hyp	+	-0.7	0.19E+03	-5.0S
Total Dissolved Solids	84	95.3	18.2	1.9HS	0.33HS	39	lin	-	1.4	0.36E+04	-4.8
Suspended Sediment	59	16.6	18.7	-10.9HS	0.40HS	41	hyp	+	-4.2	0.98E+03	-4.3HS
Conductivity (um/cm)	101	179.3	38.5	2.6HS	0.28HS	41	lin	-	2.0		
Turbidity (JTU)	35	8.6	8.1	-11.6	I.D.	16			I.D.		
Fecal Coliform (col/100 ml)	44	5604.8	15287.5	-17.9HS	0.30HS	29	lin	+	-10.0		
Fecal Strep. (col/100 ml)	47	612.8	1664.0	-4.6	0.05	31	lin	+	-4.6		
Phytoplankton (cells/ml)	41	19250.5	35899.0	0.1	0.13	28	hyp	-	-15.2		
Dissolved Oxygen	93	10.5	2.6	1.2S	0.51HS	37	hyp	+	2.5		

Heavy Metals (sampled quarterly)	N	DETECTION LIMIT	Concentration (ug/l) MEDIAN	MEAN min	max	TREND	Exceedence of Quality Standards Water Supply std (ug/l)	freq	Aquatic Life std (ug/l)	freq	Transport (metric tons/d N	MEAN min	max
Aluminum	1	100.0	<=D.L.	0.0	81.0	I.D.	D.L.	0.00	no std.		0	I.D.	I.D.
Arsenic	26	1.0	<=D.L.	1.0	1.6	+ HS	50.0	0.00	no std.		15	0.42E-01	0.56E-01
Barium	14	100.0	<=D.L.	21.4	109.1	I.D.	1000.0	0.00	no std.		11	0.31E+00	0.34E+01
Boron	1	20.0	<=D.L.	0.0	7.0	I.D.	D.L.	0.00	no std.		0	I.D.	I.D.
Cadmium	22	20.0	<=D.L.	1.0	12.7	-	D.L.	0.05	no std.		16	0.33E-01	0.41E+00
Chromium	23	20.0	<=D.L.	2.6	18.3	+	50.0	0.00	100.0	0.00	16	0.59E-01	0.53E+00
Cobalt	23	100.0	<=D.L.	0.5	49.0	I.D.	D.L.	0.00	no std.		16	0.94E-02	0.16E+01
Copper	29	20.0	<=D.L.	6.2	15.2	-	1000.0	0.00	no std.		16	0.21E+00	0.39E+00
Iron	33	10.0	510.0	873.2	873.2	+	300.0	0.76	1000.0	0.18	16	0.26E+02	0.26E+02
Lead	29	200.0	<=D.L.	13.9	21.0	I.D.	D.L.	0.00	no std.		16	0.39E+00	0.44E+00
Manganese	32	10.0	50.0	57.9	58.2	-	50.0	0.47	no std.		16	0.15E+01	0.15E+01
Mercury	28	0.5	<=D.L.	0.0	0.4	I.D.	2.0	0.00	0.5	0.00	15	0.00E+00	0.11E-01
Nickel	7	200.0	<=D.L.	2.6	3.4	I.D.	D.L.	0.00	no std.		4	I.D.	I.D.
Selenium	21	1.0	<=D.L.	0.1	1.0	-	10.0	0.00	no std.		15	0.34E-02	0.31E-01
Silver	13	20.0	<=D.L.	0.0	17.1	I.D.	50.0	0.00	no std.		11	0.00E+00	0.56E+00
Zinc	22	20.0	30.0	31.8	36.4	+	5000.0	0.00	no std.		16	0.78E+00	0.91E+00

-- Summary Statistics for the Potomac River NASQAN Station

Station ID	Station Location		
16465.80	POTOMAC R AT CHAIN BRIDGE, AT WASH, DC	Mean Discharge (cfs) 12484	Drainage Area (sq mi) 11570

Beginning year of record 1973

Common Quality Constituents (sampled monthly)	N	Concentration (mg/l) MEAN	STANDARD DEVIATION	TREND (%/yr)	Flow Adjusted Concentration REGRESSION vs FLOW r squared	N	type	slope	TREND (%/yr)	Transport (metric tons/day) MEAN	TREND (%/yr)
Temperature (degrees C.)	96	15.8	9.6	-0.7	0.17HS	96	hyp	-	-1.4		
pH (standard units)	96	8.2	0.4	-0.0	0.32HS	96	hyp	-	-0.1	0.41E-06	0.1
Alkalinity	89	76.6	20.8	0.5	0.48HS	89	hyp	-	0.8	0.24E+04	-1.1
Sulfate	94	39.0	16.6	2.6S	0.75HS	94	hyp	-	1.9HS	0.90E+03	0.8
Nitrate-Nitrite	83	0.91	0.50	5.5HS	0.37HS	83	hyp	+	5.6HS	0.57E+02	0.9
Kjeldahl Nitrogen	90	0.6	0.4	0.5	0.16HS	88	hyp	+	-0.4	0.21E+02	1.4
Total Organic Carbon	49	5.8	3.1	-4.7	0.02	49	lin	+	-4.7	0.18E+03	-2.2
Phosphorus	92	0.10	0.11	-0.0	0.39HS	90	hyp	+	-2.1	0.39E+01	-0.6
Calcium	90	32.3	7.7	0.0	0.45HS	90	log	-	0.3	0.86E+03	-0.6
Magnesium	90	7.6	2.3	-0.4	0.75HS	90	hyp	-	0.6	0.19E+03	-0.1
Sodium	90	11.8	7.3	2.5	0.72HS	90	hyp	-	2.0	0.24E+03	1.5
Potassium	90	2.3	0.7	0.0	0.24HS	90	inv	-	0.4	0.65E+02	-0.2
Chloride	94	12.3	6.5	3.2S	0.61HS	94	hyp	-	3.1HS	0.27E+03	2.1
Silica	93	3.9	2.4	2.6	0.37HS	91	hyp	+	1.7	0.24E+03	1.4
Total Dissolved Solids	89	156.4	43.8	0.1	0.65HS	89	hyp	-	0.5	0.40E+04	0.3
Suspended Sediment	79	71.2	130.2	-1.4	0.52HS	78	hyp	+	-1.8	0.33E+04	-0.4
Conductivity (um/cm)	92	284.5	72.6	1.2	0.63HS	92	log	-	1.0S		
Turbidity (JTU)	61	36.6	79.6	-9.1HS	0.19HS	61	hyp	+	-13.3HS		
Fecal Coliform (col/100 ml)	50	559.4	1641.1	0.3	0.32HS	50	hyp	+	-10.0		
Fecal Strep. (col/100 ml)	50	987.0	1713.4	-3.2	0.35HS	50	hyp	+	-4.1		
Phytoplankton (cells/ml)	72	27002.5	29935.3	-1.5	0.23HS	71	hyp	-	-6.6S		
Dissolved Oxygen	39	10.6	1.9	-0.2	0.11S	39	hyp	+	0.1		

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Heavy Metals (sampled quarterly)	N	DETECTION LIMIT	Concentration (ug/l) MEDIAN	MEAN min	MEAN max	TREND	Exceedence of Quality Standards Water Supply std (ug/l)	freq	Aquatic Life std (ug/l)	freq	Transport (metric tons/d N	MEAN min	MEAN max
Aluminum	12	100.0	300.0	1763.3	1763.3	I.D.	D.L.	1.00	no std.		12	0.67E+02	0.67E+02
Arsenic	31	1.0	<=D.L.	0.5	1.2	-	50.0	0.00	no std.		31	0.16E-01	0.36E-01
Barium	14	100.0	<=D.L.	28.6	110.7	I.D.	1000.0	0.00	no std.		14	0.55E+00	0.31E+01
Boron	0	20.0	I.D.	I.D.	I.D.	I.D.	D.L.	0.00	no std.		0	I.D.	I.D.
Cadmium	30	20.0	<=D.L.	0.1	14.0	I.D.	D.L.	0.00	no std.		30	0.18E-02	0.39E+00
Chromium	30	20.0	<=D.L.	3.0	19.0	+	50.0	0.00	100.0	0.00	30	0.84E-01	0.54E+00
Cobalt	31	100.0	<=D.L.	1.6	40.9	I.D.	D.L.	0.00	no std.		31	0.85E-01	0.82E+00
Copper	31	20.0	<=D.L.	4.4	13.6	-	1000.0	0.00	no std.		31	0.15E+00	0.39E+00
Iron	31	10.0	690.0	1965.8	1965.8	+	300.0	0.77	1000.0	0.39	31	0.85E+02	0.85E+02
Lead	31	200.0	<=D.L.	46.4	59.4	+	D.L.	0.06	no std.		31	0.11E+01	0.14E+01
Manganese	32	10.0	75.0	131.7	132.7	+	50.0	0.63	no std.		32	0.51E+01	0.51E+01
Mercury	31	0.5	<=D.L.	0.0	0.4	I.D.	2.0	0.00	0.5	0.00	31	0.00E+00	0.12E-01
Nickel	11	200.0	<=D.L.	11.9	12.4	I.D.	D.L.	0.00	no std.		11	0.52E+00	0.53E+00
Selenium	28	1.0	<=D.L.	0.1	1.1	-	10.0	0.00	no std.		28	0.66E-03	0.27E-01
Silver	15	20.0	<=D.L.	0.2	17.7	I.D.	50.0	0.00	no std.		15	0.29E-02	0.55E+00
Zinc	31	20.0	30.0	41.3	47.7	+	5000.0	0.00	no std.		31	0.12E+01	0.13E+01

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Table C.--A Comparison of Significant Trends[1] in Water Quality for the Hudson and Potomac Rivers, 1973-1981

	Up Trends	(% per yr)	Down Trends	(% per yr)
Hudson River	nitrate-nitrite	(2.7)	temperature	(-5.2)
	sodium	(10.8)		
	potassium	(2.8)		
	chloride	(5.8)		
	arsenic	(*)		
Potomac River	nitrate-nitrite	(5.6)	turbidity	(-13.3)
	sulfate	(1.9)	phytoplankton	(-6.6)
	chloride	(3.1)		
	conductivity	(1.0)		

[1] Flow adjusted trend, significant at .05 level

* Trend slope not estimated for heavy metals

The PCB Contamination Problem of the Hudson River

Reports in preparation by USGS indicate that PCB concentrations in 1981 have decreased to about one-third the level that persisted in 1977. Point sources were eliminated about that time, thereby reducing continued contribution of PCB to the river.

Before termination of PCB discharge, PCB accumulated in a river pool retained by a dam. When the dam was removed, massive quantities of PCB-laden sediment that had collected behind the dam were washed downstream. Estimates show that 650,000 pounds of PCBs were present in Hudson River sediment. Concentration of PCBs in the sediment generally decrease downstream from more than 1,000 parts per million at Fort Edward (see attached report, Fig. 2) to less than 10 parts per million in the harbor at New York City. These sediments are believed to be the source of PCBs in the Hudson River water.

In the upper Hudson River, the relationship between concentration of PCBs and water discharge is expressed as a U-shaped curve (see attached report, Fig. 3). Increases at high discharge are due to resuspension of contaminated sediment in the river water. The increase in PCB concentration at low discharge is due to a constant source of PCBs seeping from bottom sediment into the water column.

In the Hudson River Estuary, average PCB concentration decreases from 0.25 parts per billion near the head of the estuary to 0.1 part per billion 100 miles downstream.

Differences between concentrations at the head of the estuary and downstream sites are attributed to dilution by tributaries and perhaps in part to losses by volatilization.

New York State Department of Health has set drinking water standards at 0.1 part per billion. Analyses of treated water rarely exceed the drinking water standard.

The clean-up plan requires dredging the contaminated sediments. Dredging should decrease total PCBs in sediments of the upper river by one-half. Water sampling will continue through 1986.

The attached article from USGS Circular 875 gives a more detailed discussion of the PCB problem.

General Water Quality of the Tidal Potomac River - Early 1980's

The summertime water quality of the tidal Potomac River from Washington, D.C. to Mt. Vernon has improved significantly since the deplorable conditions (floating algal mats, low dissolved oxygen, odors, and floating trash) of the late 50's and early 60's. Upgrading all area sewage plants to secondary treatment, phosphorus removal, and closing major leaks in the sewage lines were responsible for most of the improvement. A significant, but less publicized, fact is that the July through September river flow was 2,700 cubic feet per second in the 1960's decade and fortuitously increased to 6,300 cubic feet per second in the 1970's decade. The increased flow diluted sewage plant discharge and transported the wastes out of the Washington area more quickly. The result of the natural increase in flow and the improved sewage treatment is the river we see today.

In the last 3 years, a few obvious, dramatic improvements in river quality have occurred, including the reappearance of isolated beds of submerged aquatic vegetation, lack of offensive algae blooms, and generally good dissolved oxygen conditions.

A less obvious but very costly improvement is the decline in ammonia concentrations in the river near the Washington area. New nitrification facilities at Washington's Blue Plains Advanced Waste Water Treatment Plant reduced the summertime (July and August) ammonia discharge (as nitrogen) from 9.2 metric tons per day in 1980 to 1.5 metric tons per day in 1981. The nitrate discharge increased from 4.7 metric tons per day to 14 metric tons per day and the 5-day Biochemical Oxygen Demand decreased from 22 metric tons per day to 9.5 metric tons per day. The river response to these changes was mixed. The low point of the dissolved oxygen sag in 1981 was about 6 milligrams per liter, which was about 2 milligrams per liter above the low point 1980 concentration. At most locations, however, the DO increase was less than 1 milligram per liter.

The mass of chlorophyll-a, used as an indicator of algae biomass, was the same in 1980 and 1981 although its distribution changed from a maximum concentration downstream of Mt. Vernon in 1980 to maximum concentrations at Alexandria and downstream of Mt. Vernon in 1981.

There has been an invasion of the river by the Asian clam, Corbicula fluminea, in such large numbers that it has been credited with decreasing the algae population near Alexandria and has caused problems by clogging the cooling water systems of local power plants.

From "USGS 1981 Fiscal Year Activities", Circular 875

THE HUDSON RIVER ASSESSMENT

In the late 1960's and early 1970's, nearly four decades after the introduction of polychlorinated biphenyls (PCB's) into commercial use, scientists began to be aware of widespread PCB dispersion in the environment and the resultant possibility of hazard to health. The discharge of PCB's into the Hudson River from about 1950 to 1977 had resulted in serious degradation of the river as a source of food and drinking water.

In 1976, the Geological Survey, as part of its Federal-State Cooperative Program and in cooperation with the New York State Department of Environmental Conservation and the Board of Water Commissioners of the Town of Waterford, began a study of PCB's in the Hudson River to determine concentration and transport rate of PCB's in the river and to provide a basis for deciding what actions should be taken to reduce the level of contamination.

History of the Problem

PCB's are actually a group of closely related compounds, the molecular structure of which is illustrated in figure 1. Between 1 and 10 chlorine atoms can be attached in any of the 10 substitution sites (X) on the biphenyl portion, creating over 200 possible compounds. Commercial mixtures contain a number of these compounds whose chlorine content is dependent on the particular manufacturing process used by the producer. At the time of the Hudson River assessment, the only important U.S. producer was Monsanto Chemical Company which marketed PCB's under the trademark of Arochlors until production was discontinued in 1977.

Although PCB's had a variety of uses, their major use was in electrical capacitors and transformers, where their resistance to degradation at high temperatures made them particularly valuable as insulators and coolants. The General Electric Company purchased PCB's for use in manufacturing of electrical equipment at plants in Fort Edward and Hudson Falls. Records indicate that between 1966 and 1974 these two plants accounted for 15 percent of all domestic purchases of PCB's.

Discharge of PCB's from two outfalls on the Hudson River dates back to about 1950, although records of the actual volume discharged are available only for the past 10 years. These records show that the quantity averaged 35 pounds per day in the early 1970's. Discharge was terminated in 1977. Wastes accumulated in a river pool retained by the Old Fort Edward Dam, a 150-year-old stone-and-wood structure used for generation of hydroelectric power. In October 1973, when the dam was removed, massive quantities of PCB-laden sediment that had collected behind the dam were washed downstream. It is estimated that about 650,000 pounds of PCB's are

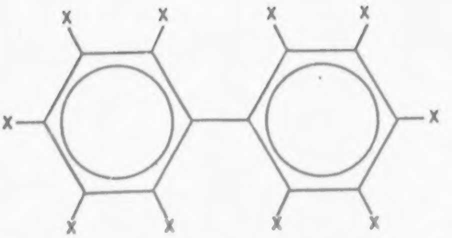

FIGURE 1.—*Structure of polychlorinated biphenyls.*

now present in Hudson River sediments. Concentrations of PCB's in the sediment generally decrease downstream from more than 1,000 parts per million at Fort Edward to less than 10 parts per million in the harbor at New York City. These sediments are believed to be the source of PCB's in the Hudson River water.

Upper Hudson River

The Hudson River above the head of the tidal estuary at Troy is marked by a series of low-level dams used for navigation and power generation. The 45-mile reach from Troy north to Fort Edward contains eight dams. Samples of river water are being collected by the Geological Survey within this reach at Rogers Island (near Fort Edward), Schuylerville, Stillwater, and Waterford. Locations are shown on figure 2. In addition, background samples are being collected from a bridge at Glens Falls upstream from the contaminated reach. PCB's have not been found at the background station.

Figure 3 shows the relationship between concentration of PCB's and water discharge expressed as a U-shaped curve. The increase at very high discharge is due to resuspension of contaminated sediments in the river water. These high discharges typically occur only during a few days of spring snowmelt, but, during this time, as much as one-third of the total annual PCB transport may occur. Figure 3 indicates that the relation between concentration and discharge during these floods differ from year to year. This variation is partly a reflection of the alternating covering and reexposure of PCB-laden sediments on the river bottom; but the major cause is the variation in source of flood flow, which may be either far upstream, passing over the more contaminated reaches, or further downstream, passing over the less contaminated reaches. Similar results also have been found at Stillwater and Waterford.

The increase in PCB concentration at low discharge is due to a relatively constant source of PCB's seeping from bottom sediment into the overlying water column. In contrast to the periods of very high discharge when PCB's are attached to suspended sediment, the balance of the time they are found mainly in the dissolved phase. Average flux (excluding floods) is calculated to be 2 pounds per day at Rogers Island and 10 pounds per day at Schuylerville, Stillwater, and Waterford, with quantities decreasing by about one-half since 1980. The fact that nearly identical fluxes are observed at the three downstream sites indicates that the most highly contaminated sediments are still upstream from Schuylerville.

Hudson River Estuary

The 150-mile tidal reach of the Hudson from Troy to the Battery in New York City has suffered the major economic impact of contamination. Commercial fishing for nearly all species has been banned and sport fishing has been curtailed substantially. The New York State Department of Environmental Conservation estimates economic losses may be as high as $25 million annually.

Water samples have been collected from late spring to early fall in the upper two-thirds of the estuary since 1978. Average PCB concentration decreases from 0.25 part per billion near the head of the estuary to 0.1 part per billion 100 miles downstream; average concentration during the same period at Waterford is 0.4 part per billion. The difference between concentrations at Waterford and the head of the estuary is due to dilution by the Mohawk River which contains no PCB's and enters the Hudson just below Waterford. Further decrease in concentration at downstream sites in the estuary is due to dilution by tributaries and perhaps in part to losses by volatilization.

Drinking Water

Numerous private households, institutions, and communities use the Hudson River as a source of drinking water. Waterford and Poughkeepsie (80 miles south of Troy) are the major users of public supplies. The standard for finished drinking water has been set by the New York State Department of Health at 0.1 part per billion.

Most monitoring has been done at Waterford rather than Poughkeepsie because PCB concentration is known to be higher there than in the estuary. Concentrations in raw and treated water have been measured. Results show that the concentration in treated water rarely exceeds the drinking water standard.

During high discharge, removal is achieved readily simply as a byproduct of the settling processes that remove suspended sediment from the

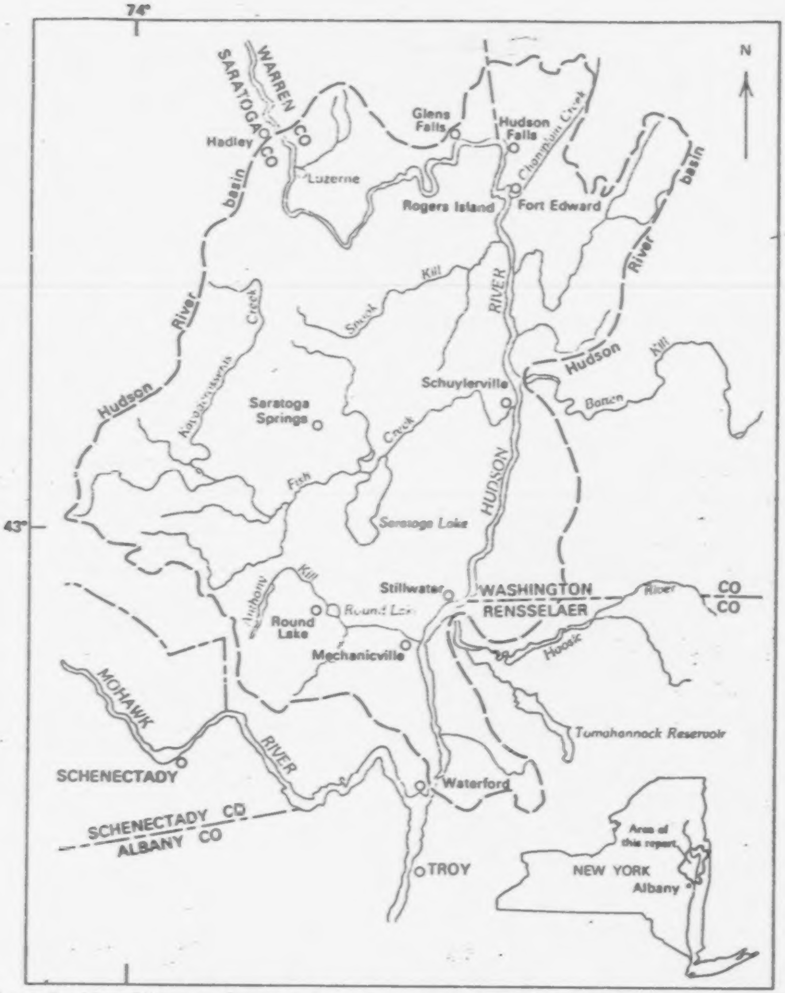
74°
43°
N
WARREN CO
SARATOGA CO
Hadley
Luzerne
Glens Falls
Hudson Falls
Champlain Creek
Rogers Island
Fort Edward
Hudson River basin
Hudson River basin
Snook Kill
Kayaderosseras Creek
RIVER
Hudson
Batten Kill
Schuylerville
Saratoga Springs
Fish Creek
Saratoga Lake
HUDSON
Anthony Kill
Stillwater
WASHINGTON CO
RENSSELAER CO
River
Round Lake
Round Lake
Mechanicville
Hoosic
MOHAWK RIVER
Tomhannock Reservoir
SCHENECTADY
Waterford
SCHENECTADY CO
ALBANY CO
TROY
Area of this report
NEW YORK
Albany

FIGURE 2.—*Map of Upper Hudson River Basin showing major tributaries and location of sampling sites.*

raw water. During the rest of the year, when a significant fraction of the PCB's is present in the dissolved phase, removal is achieved by the combination of settling, coagulation, and charcoal filtration processes used for water purification.

Cleanup Plan

If PCB transport rates were to remain constant in the future, it would take nearly a century to move the total accumulation of PCB's from the upper river. Even though covering of old contaminated sediments with new uncontaminated sediments and natural degradation of PCB's could shorten the interval, the length of time necessary for the river to clean itself by natural processes is still very long. For this reason, the U.S. Environmental Protection Agency and the New York State Department of Environmental Conservation

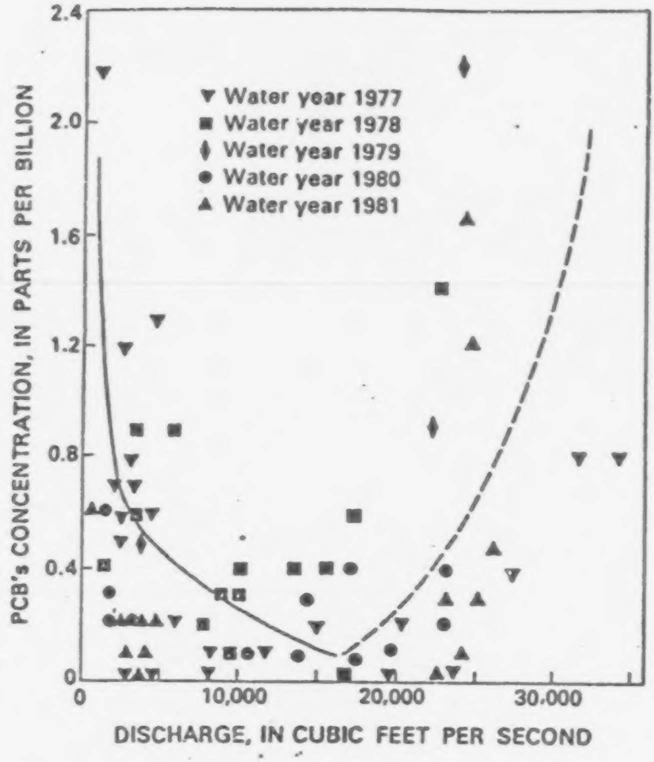

FIGURE 3.—*Results obtained for Hudson River at Schuylerville illustrating U-shaped relation between concentration of polychlorinated biphenyls and river discharge. Dashed line represents "average" conditions during spring snowmelt flood period; solid line is derived from regression relation between concentration and inverse discharge during remainder of year.*

have decided to spend $26.7 million to remove contaminated sediments by dredging.

Dredging for removal is planned to begin in 1982 or 1983 and will be completed in 1 year. Dredging will remove sediments from about 30 "hot spots" above Schuylerville where concentration of PCB's exceeds 50 parts per million. The sediments will be stored in a clay encapsulation site on 250 acres a few miles south of Fort Edward. Removal of these hot spots will decrease total PCB's in sediments of the upper river by nearly one-half and should, therefore, result in a comparable decrease in concentrations and loads transported by the river. Water sampling on the upper Hudson is scheduled to continue through 1986 to compare "before and after" dredging concentrations.

QUESTION #1

Questions and answers - Dr. John Hernandez

QUESTION

In your view, what are the Nation's most serious water pollution problems and how should these problems be addressed by EPA, the States, and others? What information (i.e., research) is needed to address these problems and who should be responsible for developing this information?

ANSWER

Many municipal and industrial point source water pollution problems have already been identified and are currently being addressed through the BPT and BAT effluent guidelines and State water quality standards processes. In some cases, these processes are working even more effectively than we originally anticipated. For example, BPT discharge limits and existing BPT permits were originally aimed at controlling conventional pollutants; they are, however, also serving to control toxic organics and heavy metals to a significant degree. We have also found that heavy metals are being reduced through secondary treatment in publicly owned treatment works (POTWs). These then are examples of water pollution control measures that are already in place and that are correcting water quality problems.

In terms of other water pollution problems, it is difficult for us to identify the most serious problems that remain because we do not now have a clear idea of where or how beneficial stream uses are being impaired by pollution. Most of our current information on water quality consists primarily of data on physical and chemical parameters; however, we are lacking the data on biological conditions and stream uses, which are needed to assess the exact nature and extent of the impacts of pollutant discharges on water quality.

States, of course, play the lead role in setting water quality standards and conducting site specific analyses to determine the environmental and physical factors that impair the attainment of a use in given stream segment. EPA is now placing more emphasis on this State role, and will continue to provide States with the needed technical guidance and support to help them collect data necessary to identify where and how uses are being impaired. For example, the FY 1983 program guidance for Regional and State water pollution control programs (which governs EPA staff and use of Federal grant funds by States) places highest priority on: (1) identifying those water bodies where the implementation of technology-based controls will not be sufficient to protect water uses; (2) gathering/analyzing the necessary information to determine what additional controls are necessary and whether additional costs are commensurate with the benefits to be attained; (3) identifying where other factors (such as physical conditions) contribute more substantially than water quality to non-attainment of a water use; and (4) refining the water quality standards as necessary to make them fully usable as a basis for regulatory decisions.

As States go through this process, we anticipate that many will identify specific water quality problems for which EPA has already conducted the basic research and has developed the cost-effective control techniques. For example, States may determine that nonpoint sources (NPS) of pollution are contributing significantly to the impaired used. EPA has done extensive work in the area of NPS pollution, and has developed measures such as Best Management Practices (BMPs) for controlling pollution caused by agricultural and storm water runoff.

On the other hand, there are water pollution problems with which EPA has had considerably less experience and for which data are insufficient. Ground water contamination, for example, is a potentially serious problem that EPA is beginning to address through the Administrator's ground-water protection policy. EPA has, however, already provided increased funding for ground-water R&D, and any additional R&D needs will be identified as the approved ground-water policy is implemented.

Q-2. The Agency recently issued its plan for its water quality research program (i.e., Research Outlook for 1982). How was this plan developed and was it reviewed by the Science Advisory Board for its scientific merit and reasonableness?

A-2. Like the other chapters of the 1982 Research Outlook, the initial draft of the Water Quality chapter was developed from the Research Committee strategy documents and other planning documents. This draft was reviewed and revised by ORD's Water Quality Research Committee co-chairman. Subsequent drafts were reviewed and critiqued by the EPA's Office of Water, which reviewed the chapter twice and approved its final form.

In previous years, the chapter would also have undergone Science Advisory Board (SAB) review simultaneously with program office review. However, at the request of the SAB, they were only sent the final draft of the Outlook simultaneous with its transmittal to Congress (June 7, 1982). The SAB met on July 8, 1982 to review the 1982 Outlook and we expect their comments shortly. When we receive these comments they will be forwarded along with EPA's response to these comments, to Congress.

Question #3

QUESTION:

You claim that water quality has improved over the last decade. The United States Geological Survey, however, testified on Tuesday that such a claim could not be made based on available data it has collected and evaluated. Please respond to this discrepancy. On what information do you base the claim that water quality is improving? Are monitoring activities and data generated from them sufficient to assess accurately trends in water quality?

ANSWER:

The statement that water quality is improving is based on the large number of cases reported by EPA Regional Offices, as well as States and local governments. The more widely reported improvements have occurred on river segments which were previously severely polluted and have now been at least partially restored for recreation, aquatic life support, and other beneficial uses. Several dozen of these cases were presented in EPA's 1980 report entitled "National Accomplishments in Pollution Control: 1970-1980, Some Case Histories." Additional examples of cleanup are being provided by the States in their biennial water quality reports to Congress prepared under Section 305(b) of the Clean Water Act.

The reason that the U.S. Geological Survey has reached a different conclusion on water quality trends is that its analysis is based on data from a limited number of fixed monitoring stations which are generally located at the mouths of major rivers and are often many miles from the major pollution sources. Therefore, the pollutant loadings have been largely dissipated and/or diluted by the time they reach those stations, and the effects of changes in pollutant loadings are not readily apparent.

EPA is taking steps to improve the information available to help make local water pollution control decisions, and to document improvements in water quality. In cooperation with other Federal agencies, States, and industrial, environmental, and municipal interest groups, EPA is developing a water monitoring strategy to improve the use of monitoring resources for these purposes. Furthermore, EPA's guidance to the States emphasizes improved analysis and reporting of environmental information in their Section 305(b) reports to make them more useful for documenting water quality problems and trends.

QUESTION #4

QUESTION:

4. You state that "EPA has developed most of the technical and economic information needed to support (Clean Water Act) standards that remain unfinished." If this is true, then why has EPA asked the courts to allow delays in issuing these standards? When will these standards be issued and how does the Agency intend to enforce them?

ANSWER:

Please see response to Question #5.

QUESTION #5:

° What is the real answer to why EPA has not promulgated these standards?
° Does EPA have the necessary scientific, technical, and administrative expertise to issue these standards?

ANSWER:

° The task of proposing and promulgating effluent guidelines is inherently complicated. It is extraordinarily difficult and time consuming to analyze all available data, determine whether the data are sufficient, properly consider all the statutory factors, assure and evaluate the quality of the analysis, and select a regulatory control option. It simply takes time to complete the effluent guidelines rulemakings and to deal with the complexities of each industrial point source category. Furthermore, technical complexities are compounded by administrative difficulties such as routine personnel attrition, training of new personnel, contractor performance, and printing and word-processing delays. We believe that the level of resources presently allocated for FY 82 and 83 is sufficient to meet the schedules presented to the court on June 21, 1982.

Perhaps the best way to explain why EPA has had to request deadline extensions for promulgating its regulations is to give concrete examples of various problems incurred, a description of the rulemaking process, and the technical complexities of the industrial categories.

Each regulation is a complex undertaking with numerous technical, economic, and policy issues that have to be resolved; issues that cannot be resolved quickly. The extreme complexity of developing an industry profile, for example, frequently necessitates long term approaches to studying regulatory options.

For example, the Nonferrous Metals category Phase I effluent limitations and guidelines is among the most complicated of the regulations. This category consists of 13 subcategories, virtually all of which constitute distinct manufacturing categories (c.f., the primary zinc manufacturing process is quite unlike the primary aluminum manufacturing process). Moreover, all principal aspects of relevant engineering data (wastewater flow, pollutants, control measures) vary markedly from subcategory to subcategory. In summary, each of these production processes is very complicated, most of the plants in each subcategory have large wastewater flow, and the possible economic impacts of this regulation may be substantial. Given these factors, the magnitude of the task is apparent.

Another example is the Organic Chemicals/Plastics and Synthetics Materials regulation which will cover over 400 production processes and over 20,000 products. It has taken EPA several years to collect all the relevant data to allow it to address the multiplicity of production processes to be covered by the regulation. There are over 2 million pages of raw data. Complicated engineering and statistical analysis must be performed to verify the data in order to establish the basis for defensible effluent limitations and standards. Similar difficulties are faced in developing the economic analysis for this industry. A complicated economic model must be developed representing the economic data base containing approximately 70,000 data points covering 600 plants.

Once the technical work is done and the critical issues resolved, a regulation must be proposed and the Agency is required by law to give all interested parties an opportunity to participate in the rulemaking process. The Agency must reserve in each schedule 60 - 90 days for the public to review the proposal and submit comments. Interested persons must review the regulation plus the extensive record that supports each regulation. This record is often in excess of 50,000 pages. It is often the case that serious challenges to at least portions of the regulation are raised during the comment period. Commenters frequently challenge the validity and statistical analysis of the data. This means that the Agency must then review the data and analysis supplied by the commentor, and may have to gather additional data and perform additional analysis prior to final promulgation of the rule.

As an example, the commenters on the Leather Tanning regulation persuasively argued that the technical and economic data supporting the proposed limitations for the industry were inadequate and contained a large number of errors. The Agency responded by reviewing the entire data base and all documentation supporting the rulemaking. In addition, the Agency conducted a supplemental data gathering program. This program involved 56 information request mailings, 43 site visits, and 10 wastewater sampling visits. The Agency acquired a significant amount of additional information and data on production levels, wastewater flow, methods of reducing flow, and control and treatment technology performance cost. Subsequently, additional statistical analysis was performed on the revised technical data base to develop new effluent limmitations and standards. EPA also reevaluated the cost of the regulation and its methodology for assessing the economic impacts of complying with the proposed regulation. This entire process was time consuming and painstaking; it took approximately 16 months in total.

In response to the proposed Iron and Steel regulation, the Agency received extensive comments that its data did not support the proposed BAT limitations for Hot Forming operations. In response to that comment the Agency conducted extensive sampling at 15 Hot Forming operations which took 26 weeks.

Prior to proposal the Agency may also recognize that additional time will be needed to review comments on the proposed effluent limitations and standards. One such example is the Pesticides regulation. Although the Agency will be ready to propose the Pesticides effluent guidelines regulation in November 1982, it will not be able to propose the analytical methods underlying the effluent limitations until January 1983. This will necessitate a separate public comment period on the analytical methods. The Agency anticipates that there will be extensive public comment on these methods because they have never been formally reviewed. Only after consideration of all the comments can the Pesticides regulation and the related analytical methods be promulgated.

After comments have been reviewed and any additional data gathering or analysis accomplished, the Agency must then prepare the formal rulemaking documents. These documents consist of the preamble, regulation, technical and economic documents, and a detailed reponse to the public comments. The documents are routinely very lengthy. For example, the Iron and Steel regulation and its preamble was 361 typewritten pages; the technical support document was 6 volumes, each approximately 500 pages; the economic support document was 400 pages; and the comment response document was 100 pages. All of these documents must be prepared, edited, and reviewed by all concerned offices within EPA. This represents an enormous task which requires 1 - 3 months.

The schedules EPA submitted to the Court on June 21, 1982, are in direct response to the May 7, 1982 court order and provide no time for unanticipated problems. The Agency does have the necessary administrative, technical, and scientific expertise to issue these standards, but the problems and issues such as those outlined above require the Agency to ask for deadline extensions.

The Agency has taken the necessary actions to avoid resource constraints that might materially affect the June 21 schedule. Technically competent personnel have been made available to ensure that the projects are properly staffed, and the technical and economic studies required for these projects are fully funded.

QUESTION #6 (a)

Question:

- Do you propose that utilization of this water quality approach happen only after BAT is in place by industries? Why?

Answer:

- No. In fact, EPA and the States are presently implementing the water-quality based approach for some industries. For example, some pulp and paper mills have had water quality based controls (based on dissolved oxygen levels) for many years. Water quality based permits have also been written for many municipal dischargers. In those cases where we are able to predict the needed level of treatment, e.g., using site-specific water quality criteria and mathematical models, we can and do implement water quality based controls.

QUESTION #6 (b)

QUESTION:

If States are allowed to adopt more reliance on the water quality-criteria approach and modify EPA water criteria, what safeguards are there to prevent States from tailoring their standards to protecting existing local industries or to attract new industrial development via less strict requirements?

ANSWER:

The existing water quality standards regulation and the revisions currently being developed recognize the State's primacy in establishing attainable water body uses and site-specific criteria to protect these uses. The Agency has proposed guidance packages in these areas in order to assist the States in their responsibilities. In addition, States must submit to the appropriate Regional Administrator sufficient data and analysis to support proposed changes in water body standards -- either changes in uses or changes in the criteria to support these uses. The Agency will use the appropriate guidance packages (such as those covering use attainability analyses and site-specific criteria development) to evaluate the adequacy of State submissions. States are also required to make their proposals and the underlying information available for public scrutiny.

QUESTION #6 (c)

QUESTION:

- Have analytical techniques and monitoring methodologies for the priority pollutants been approved by EPA?

ANSWER:

- EPA has published approved analytical techniques and monitoring methodologies for 120 of the 129 priority pollutants in regulations written under the authority of Section 304(h) of the CWA (40 CFR 136). EPA proposed amendments to 40 CFR 136 in December, 1979 to cover the remaining eight parameters and adding additional techniques and monitoring methodologies for a number of organic chemicals. Techniques and monitoring methodologies are not being proposed for asbestos.
- After several extensions, the comment period for the proposed amendments closed January 13, 1981. EPA expects to promulgate the amendments in September, 1982.

QUESTION #6 (d)

Question:

- o Is the water quality based approach to water pollution control enforceable?

Answer:

- o Yes. The water quality based approach practiced today does contain enforceable permit conditions. There are two clear mandates in the Act for enforcing water quality based controls by incorporating them into National Pollution Discharge Elimination System (NPDES) permits:

  - First, pursuant to sections 301(a) and 402(a)(1) of the Act, the discharge of any pollutant by any person is unlawful, unless an NPDES or 404 permit has been issued for the discharge; and, if such a permit is issued, it must meet all applicable requirements of section 301. One of these requirements which must be met is found in section 301(b)(1)(C): "In order to carry out the objective of this Act there shall be achieved...any more stringent (effluent) limitation, including those necessary to meet water quality standards...." Many NPDES permits contain effluent limitations based on wasteload allocations which implement applicable water quality standards, in addition to the technology requirements imposed by the Act. The Act's definition of effluent in section 502(11) also supports this position.

  - Second, section 208(e) states that "no permit under section 402 of this Act shall be issued for any point source which is in conflict with a plan approved pursuant to subsection (b) of this section," and under 40 CFR 35.1521-4 there is a requirement for such plans (i.e., Water Quality Management (WQM) Plans) to contain total maximum daily loads (TMDLs) and WLAs: "The following point and nonpoint program areas shall be addressed in the plan...total maximum daily loads, wasteload allocations." Therefore, in order to prevent conflicts with section 208(e), NPDES permits (which are enforceable) must be based on any WLAs contained in applicable approved WQM plans.

QUESTION #6 (e)

Question:

- o Is the current Administration at EPA moving towards greater emphasis on water quality-based standards for conventional and toxic pollutant control?

Response:

- o EPA is continuing to follow the process laid out in the Clean Water Act. Under this approach, all point source dischargers must, at a minimum, meet technology-based controls, and where necessary to meet water quality standards, must also meet more stringent water quality based controls.

  Since many technology-based controls are already in place, we believe that many of the upcoming control decisions will concern what additional controls, if any, are needed to meet water quality standards.

7. Question: How can EPA justify cutting research and development in the areas of toxic chemical control when our knowledge of these contaminants is so incomplete?

Answer: The reduction in water quality research primarily reflects completion of work needed to address conventional (non-toxic) water pollutants. With completion of 64 of the Water Quality Criteria for the 65 pollutant classes (129 chemicals) in 1980 it is possible for the Agency to conclude a number of projects. Completion of work related to Great Lakes eutrophication and specific Great Lakes toxic contamination problems also is reflected in the budget reduction. Finally, as a result of finishing the development of monitoring methods and assumption of the monitoring quality assurance role by the states it has been possible to make budget reductions in this area.

In FY 1982 the water quality research program will be increasingly focused on toxic pollutants. This trend will also be reflected in the FY 1983 research program.

QUESTION #8

Question

Your statement mentions that EPA has made much progress in implementing BPT and secondary treatment level requirements for industrial and municipal dischargers. What specific data do you have to document this progress?

Answer

- Data have been compiled and compared on municipal dischargers from Needs Surveys required by the Act under Section 516.

  Between 1973 and 1980, the Needs Survey shows that flow reaching municipal plants increased by 36 percent, reflecting the additional wastewater treatment facilities in place. During the same period, BOD removal rates jumped from 67.9 percent to 76.4 percent nationally, an improvement of 13 percent. Suspended Solids pollutant removal efficiencies improved from 72.0 percent to 79.6 percent, an improvement of 11 percent.

  Also using Needs Survey data from 1976 to 1980, 198 major metropolitan areas, representing 73 percent of all national flow, were studied. In 1976, only 24 percent of this flow received a minimum of secondary treatment. By 1980, 75 percent of this flow was treated at secondary levels or better.

- In terms of industrial dischargers, some 96 percent have installed the appropriate treatment technology and 84 percent of the permitted industrial facilities are meeting their BPT permit conditions.

QUESTION #9

You state that "A site specific criteria approach is under development that will allow the States to modify the EPA laboratory-derived criteria to reflect local environmental conditions."

QUESTION:

How will EPA assure that such site-specific criteria will enhance the water quality of the area?

ANSWER:

Section 304(a)(1) criteria or site-specific criteria must be evaluated once they are applied to protect a water body use. EPA will be developing guidance on the biological integrity of water bodies, as well as evaluation guidance on the efficacy of criteria to determine the ultimate impact that application of water quality-based controls have on the enhancement or restoration of water body uses.

QUESTION:

Under what specific circumstances will States be allowed to increase or decrease EPA quality criteria for water (Redbook) values to reflect local environmental conditions?

ANSWER:

EPA will be publishing guidance on site-specific criteria development. The package contains four proposals or approaches for establishing criteria based upon local biological and water quality conditions. Each of these procedures lists conditions and assumptions which must operate before the procedures may be used for establishing site-specific criteria.

QUESTION: #10

Question:

On page four of your testimony you state that EPA is developing a monitoring strategy that will be helpful to States in encouraging the use of selective biological and intensive surveys.

- When will this monitoring strategy be completed?

  Answer: This monitoring strategy is planned for completion in March 1983. It is being developed through the Standing Work Group on Monitoring and Wasteload Allocations which consists of representatives from EPA (Headquarters and Regions), States, local governments, industry, environmental groups, and other federal agencies.

- Specifically, what will this strategy involve and how will it work?

  Answer: This strategy will stress site-specific monitoring activities such as biological surveys for setting site-specific controls and the use of general assessments in the monitoring and wasteload allocation program. It is intended to assist EPA, the States, local governments, and the regulated community carry out the monitoring requirements of the Clean Water Act to focus on the most significant water quality problems. This strategy will also encourage cooperative monitoring programs involving State or local governments and industries to work together to collect site-specific data resulting in more realistic, reasonable permit limits.

- What funding sources are being used to develop this strategy?

  Answer: Funds are almost entirely in-house EPA funds. Some limited extramural funds are being used in support of the Standing Work Group on Monitoring and Wasteload Allocations and for assembling the program guidance document.

- Is this a new monitoring function?

  Answer: No. This function consists of revising the Basic Water Monitoring Program which has been the primary monitoring guidance document for the States since 1976. This document also encouraged the use of site-specific water quality problem assessments.

QUESTION #11

QUESTION

Your oral testimony that EPA will provide the States with a set of national regulations to help prevent ground water pollution caused in the past by improper disposal of municipal and industrial wastes.

- When will these regulations be promulgated and made available to the States?
- What research is EPA currently performing that addresses the problem of the cleanup of ground water already contaminated by toxic and hazardous chemicals and wastes?

ANSWER 11(a)

EPA's permitting requirements under RCRA for land disposal facilities were issued as interim - final regulations on July 26, 1982. They become effective six months from date of promulgation on January 26, 1983.

EPA's regulations for Underground Injection Control permits are currently undergoing final changes to implement court settlement of the litigation issues. The UIC regulations, implemented through EPA (or delegated State) permits, will protect ground water from injection of industrial wastes.

In addition, many ground-water contaminants are covered by current drinking water standards. National Interim Primary Drinking Water Regulations include limits for 10 inorganic chemicals, 6 pesticides, radionclides, coliform bacteria and 4 trihalomethanes. National Secondary Regulations contain limits for 12 additional substances.

Revised National Primary Drinking Water Regulations mandated by the Safe Drinking Water Act are being developed. An Advance Notice of Proposed Rulemaking for synthetic organic chemicals that are frequent ground water contaminants was published in March 1982.

Public comments are now being reviewed along with continued development of occurrence, treatment, health risk, and economics data. Proposed regulations would be published in 1983, and 1984 is the projected promulgation date for any needed regulations.

Answer: 11 (b) The kind of research that EPA conducts to address already contaminated ground water falls into three categories: containment of the contaminated water, cleanup in situ, and cleanup after withdrawal. If the contamination is restricted to a reasonably small area, research is addressing ways of containment, such as grouting curtains, trenching, or retaining walls. This is covered under the Hazardous Waste Research and Superfund Support Programs. The second area, part of the Ground Water Research Program (under Drinking Water), is addressing the costs, effectiveness, and feasibility of in situ aquifer reclamation methods, such as pumping air and nutrients into an aquifer to encourage natural biological degradation of contaminants, or pumping chemicals into an aquifer to detoxify or neutralize contaminants. The third area, removal of organic chemicals from well water, is covered under the Drinking Water Research Program and addresses technologies such as tower aeration, packed-column aeration, air-lift pumping, granular activated carbon, and ion exchange.

12. Question: Has EPA ever audited the States' use of funds under sections 106 and 208 of the Clean Water Act. If so, what were the results?

Answer: As part of ongoing grants administration, EPA periodically audits 106 and 208 grants to assure that grant funds have been expended consistent with Clean Water Act requirements and in accord with accepted fiscal management practices. These audits, while identifying minor problems from time to time, generally have found no significant problems with State management of these Federal funds.

Historically and as part of EPA's ongoing management evaluation and accountability systems, EPA Regions annually evaluate State performance with respect to their grant work programs. These reviews normally occur at mid-year. These reviews help identify emerging program and policy issues for EPA while assisting States in determining needed mid-course corrections as they implement their water pollution control programs.

13.

QUESTION:	What specific components of the "Total Pool" funds are available to the States to carry out their respective water pollution control programs?
ANSWER:	The components are grants under sections 106, 208, 205(g) and 205(j).
QUESTION:	What "Total Pool" funds have been provided to the States in FY 1980, 1981, 1982 (estimate), and 1983 (proposed)?
ANSWER:	Total program grants to States from FY 1980 to FY 1983 are listed below (in millions of dollars).

	106	208	205(g) (Obligation)	205(g) (Potential)	205(j)	Total
FY 80	48.7	37.5	42.4	(100)	None	128.6
FY 81	51.2	32.0	167.8	(100)	None	251.0
FY 82	51.2	None	65.2	(96)	24.0	140.4
FY 83	40.9	None	93.9	(96)	24.0	158.8

Section 205(g) figures are obligations. All other numbers are actual or anticipated appropriations.

Note: Section 208 funds support State water pollution control programs. However, 208 grants were made to both State and areawide agencies.

QUESTION #14

QUESTION:

Your testimony mentions that section 205(g) and section 205(j) of the Clean Water Act provide some funds to the States that can be used for permits, technical assistance, enforcement, and training.

- What proportion of these funds can be used for State Water Pollution Control Programs?
- What stipulations are there for the States to follow in transfering these funds from one category to another?
- What other sources of Federal funds are available to the States under the Clean Water Act?

ANSWER:

Both 205(g) and 205(j) are reserves from a State's construction grant allotment for specific water pollution control activities. While 205(g) is primarily for supporting delegated States' management of their construction grant programs, these funds may also be used by a State for administering 402, 404, and nonpoint source activities.

205(j) funds support water quality management planning activities. If a State satisfies the eligibility requirements for these funds in the Clean Water Act, all of these funds could be used in support of a State's water pollution control programs; 205(j) funds may also be passed-through to local areawide agencies, and there is a statutory requirement that States develop their 205(j) funding proposals in coordination with the designated areawide water quality management agencies.

In summary, States have the flexibility to use several funding sources (106, 205(g), and 205(j))to carry out their activities. Other than statutory eligibility requirements, EPA does not limit the State's ability to utilize these funds as the State can best determine its priorities for its water pollution control programs. 106, 205(g) and 205(j) are the only Federal funding sources available to States under the Clean Water Act to help support the administration and management of their water pollution control programs.

QUESTION #15

Q. One of EPA's proposed amendments to the Clean Water Act involves extending the NPDES permit life from five to ten years. What is the justification for this extension?

A. EPA is proposing that the current maximum 5 year term for an NPDES permit be extended to a maximum of 10 years. Among all the groups who have commented on CWA issues, the permit term extension has been one of the most widely supported administrative reforms. A 10 year permit would provide more certainty to industries and municipalities to plan for wastewater treatment requirements and would allow more efficient and effective use of current levels of permitting resources without loss of environmental protection.

The current permit life of 5 years theoretically requires permitting agencies to reissue an average of 20 percent of their permits each year. In practice this has not been possible due to large permitting workloads and delays in the promulgation of effluent guidelines. As a result, many permits have been extended under the Administrative Procedures Act rather than reissued or have been reissued as short-term permits. With 5 year permits this backlog can never be reduced at current permit issuing levels. Before the permitting authority can complete permit issuance of existing expired permits, the reissued 5 year permits will begin expiring once again. Extending the permit term to 10 years will (eventually) reduce the annual burden of permit reissuance and subsequently reduce the backlog.

Some groups have expressed concern that the permitting agency should have the authority to review and modify the permit conditions before the end of a permit term. We agree with this and feel that EPA and the States should be able to reopen 10 year permits to reflect changes in environmental or administrative circumstances, such as new BAT/BCT limits, water quality standards, or toxic pollutant designations. This would be accommodated in a revision of the NPDES regulations, after the statute is amended.

QUESTION #16

16. Q. Please provide for the record those regulatory reforms and administrative procedures initiated by EPA that have eased the burden on the States to more effectively carry out their Water Pollution Control Programs under existing financial constraints.

A. On June 18, 1982, EPA published in the Federal Register (47 FR 26564), (40 CFR Part 30) a proposed modification to our general assistance regulation governing grants and cooperative agreements. To reduce the regulatory burden associated with receiving such assistance, the proposal includes only items mandated by law, those required by OMB Circulars, and certain additional minimum requirements that EPA considers necessary for sound and effective financial assistance management.

EPA also published in the Federal Register an associated regulation with a direct impact on State administration. The proposed regulation (47 FR 25913, June 15, 1982), (40 CFR Part 35, Subpart A) establishes uniform administrative requirements and procedures for nine EPA grant programs providing financial assistance to continuing State and local agency environmental programs. This regulation is designed to eliminate unnecessary requirements, develop consistency, provide flexibility, and reduce the paperwork burden on the States.

Two of the nine EPA grant programs are administered under the Clean Water Act: Sections 106 and 205(j), governing the State water quality management program; and Section 205(g), governing construction grant program delegation to the States. EPA is revising the regulations for these programs to streamline and reduce unnecessary requirements in conjunction with the State financial assistance regulation (Subpart A). These latter two regulations have been designed to be consistent with the Subpart A regulation to allow for consolidation of planning, application, reporting, and evaluation processes, as appropriate. The construction grant program delegation regulation also deemphasizes Agency review and oversight of State management procedures in favor of a more flexible approach to overall program management. EPA expects to publish these regulations in a proposed form in the Federal Register in late summer.

The regulation for construction grants for wastewater treatment facilities has also been revised to ease the administrative burden on States and the grantee communities. On May 12, 1982, EPA published this revision in the Federal Register. This interim final regulation is built on the Administration's commitment to reduce regulatory burdens to a minimum while maintaining the program's environmental and financial integrity. The regulation includes items required by statute -- free of detailed procedures to be followed in carrying out the process -- and those additional minimum requirements that EPA considers necessary for effective management. One of our main program goals was to give the States a larger management role.

In conjunction with these regulatory reform efforts, EPA will also issue appropriate guidance documents. This non-mandatory program guidance will reflect our new emphasis on increased flexibility, and will lay out clear and succinct recommendations for achieving maximum benefits in the most efficient manner. Construction Grants 82 (CG 82) will include guidance for planning, design and building wastewater treatment facilities. Other guidance publications are also being developed in the areas of innovative and alternative technology, operation and maintenance, financial planning, and development of user charge systems. By linking these two efforts -- reducing mandatory requirements and providing guidance -- we hope that we can provide the greatest possible flexibility to States and local governments to effectively carry out their construction grants program.

There are two futher regulatory reforms that affect the construction grants program: The EPA regulation implementing the National Environmental Policy Act (NEPA) and the regulation implementing the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. EPA revised its NEPA regulation in March to include a procedure for obtaining a categorical exclusion from NEPA requirements as allowed under law. For our purposes a categorical exclusion is one of several categories of actions in the area of minor rehabilitation, minor expansion, replacement and minor upgrading that does not individually or cumulatively have a significant effect on the human environment and for which, therefore; neither an environmental assessment nor an environmental impact statement is required. The regulation implementing the Uniform Relocation Assistance and Real Property Acquisition Policies Act has been reformed and streamlined to eliminate unnecessary reporting and recordkeeping requirements.

Questions for Dr. Gloyna

1. Your testimony lists numerous research and development areas in sewage sludge management. What kinds of techniques are currently being developed for reclaiming the useful constituents in sludges? What kinds of special problems are involved when toxic chemicals are present in sludges?

2. Your testimony mentions that the development of cost effective quality control procedures and simplified analytical equipment are two high priority research areas for toxic pollutant control. What is the state-of-the-art in these areas? Approximately how much money does it cost to analyze a water sample by gas chromatograph or mass spectrophotometer?

3. Your discussion on the nature and value of research includes the following points: (1) long-term research, (2) research continuity is productive, and (3) research and development tells us where to go next. The current Administration is eliminating long-term research and cutting research continuity. What further ramifications do you believe these policies will have on our ability to address future water pollution problems?

Water Pollution Control Federation
2626 Pennsylvania Avenue Northwest, Washington, D.C. 20037 ☐ 202/337-2500

WPCF Reply to Questions from the House Science & Technology Committee

QUESTIONS: Your testimony lists numerous research and development areas in sewage management. What kinds of techniques are currently being developed for reclaiming the useful constituents in sludges? What kinds of special problems are involved when toxic chemicals are present in sludges?

ANSWER: Municipal sludges contain varying concentrations of plant nutrients, metals, crude protein, and even vitamin B-12. Unfortunately, research literature does not offer a clear picture of full-scale, feasible methods for routinely recovering these resources. Bench-testing and pilot-scale work is going on in many places. WPCF reported on these efforts in chapters four and six of our sludge R&D document but it is almost impossible to draw generalizations from one situation and apply them to another right now.

As you know, municipal sludge has been recognized as a source of nitrogen, phosphorous, potassium, and sulfur -- all important plant nutrients. Traces of copper, nickel, lead, and zinc add to the value of sludges as soil conditioners. Composting is the most popular method of preparing sludges for soil amendment. There are three different ways to compost: closed vessel; windrow; and aerated pile preparation. The last two are most often used in the United States, thanks to the work done by U.S.D.A. and EPA at the Beltsville, Maryland experimental station. We know, for example, that curing sludge compost produces a very dry, humus-like residue resembling commerical soil amenders that is easily stored and handled.

What we do not know, however, is whether curing is really necessary for all situations in which sludge might be used as a conditioner. Raw sludge can be dried and is useful in certain cases. Do the added costs of composting and curing increase the value of the final product enough to justify the extra expense? There is no general answer to the question. More research on it is needed.

Turning away from the traditional option of recycling sludge as a soil amender we find a variety of alternatives being pursued. Milwaukee tried to harvest B-12 from its sludge, found a practical way to get 308 pounds of pure B-12 annually, but discovered that the process was too expensive. Other people are working on the possibility of burning sludge in a oxygen-poor furnace, producing combustible gases, and then burning them to generate energy. Still other researchers are exploring the potential of combining sludges with solid waste to produce a fuel that will burn without the addition of expensive fuel oil. Incineration is the current choice for handling about 25% of the sludge we produce nationally, so some investigators are looking for ways to use the cinders and ash that are left. There are reports of using them as a binding agent in resurfacing roads, of making bricks with them, and even of pyrolyzing or thermally "cracking" sludges like crude oil to produce useful liquids. Only time will tell if these ideas have real practical value.

Regarding your question about the special problems of detoxifying sludges, I have to report that our biggest problems at the moment seem to be ignorance of process efficiency and cost, plus the ultimate fate of the products generated by detoxification. Obviously pretreatment by individual dischargers before introduction of wastewater into sewers is one important way to avoid this problem. That is why the Federation supports pretreatment programs.

But in today's world municipal sludges do act as a sink for the long list of metals and complex organic compounds that are discharged to sewers, so work on detoxification continues. Acid leaching removes metals...but it also produces an effluent with a very low pH (that is, very acidic) needing further treatment.

APS, Inc. in Pleasentville, New Jersey is working on a process to treat sludge in a rotary kiln with molten salt...at a temperature of 555 degrees Celsius. A third method being studied involves mixing sludge with colloidal sulfur and a bituminous emulsion. There are even suggestions that ionizing radiation might break down some of the chlorinated hydrocarbons in sludges.

As you no doubt can guess, detoxification appears to be extremely complicated and expensive. For many municipalities it may not be worth it. Where it is, the problem of what to do with the concentrated residues will remain. Detoxification is a classic case of an ounce of prevention being worth a pound of cure.

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2626 Pennsylvania Avenue Northwest, Washington, D.C. 20037 ☐ 202/337-2500

WPCF Reply to Questions from the House Science & Technology Committee

QUESTION: Your testimony mentions that the development of cost-effective quality control procedures and simplified analytical equipment are two high priority research areas for toxic pollutant control. What is the state-of-the-art in these areas? Approximately how much money does it cost to analyze a water sample by gas chromatograph or mass spectrophotometer?

ANSWER: Analyzing water samples for specific substances in very small concentrations is a relatively new field. In many ways it involves more "art" than technology because the design of testing procedures has not been standardized to the point where everyone is using the same procedure to test for a given substance in the same way. So my answer to your first question must be illustrative rather than definitive.

Let us assume you have taken a representative sample of the wastewater. (There are at least 13 automatic samplers on the market, but they don't give representative samples reliably.) Let us also assume you have extracted the substance for the sample so you can measure its concentration. (There are at least 32 different ways to adsorb it onto a solid; 24 ways to dissolve it in another liquid; and 22 ways to disperse it into a stream of gas.) We then find there are several ways to run GC/MS tests.

The most versatile method is called "high resolution gas chromatography." A related approach is called "gas chromatography with electron capture." Both work best when they are linked to a mini-computer that can match sample results against known chemicals and substances.

Running either analytic method is very sophisticated work; very few labs can do them. Our report on toxic pollutant R&D lists 38 different analytic programs in use so far. (See table 2.4 in the report.) I don't believe a consensus has been forged on when each program is most appropriate. Thus the state of the art in this field is a bit chaotic: we haven't settled on the best way to measure concentrations of organic compounds with the GC/MS.

A quick answer to the question of cost is this: it costs between $10 and $15 to run a anaylsis for one, pre-selected priority pollutant. It costs approximately $2,000 to analyze a sample for all 127 priority pollutants. But quick answers such as these disguise a lot of other costs.

For example, the minimum cost of basic GC/MS system is $75,000. It could rise to twice that much, depending on the level of sophistication desired. Since the 127 priority pollutants subdivide into eight groups, each requiring ancillary lab equipment for sample extraction and isolation, the added cost of support equipment is about $31,500. Next one has to add the cost of building a lab to house the equipment. One municipal treatment authority recently finished such a laboratory. The 2,600-square foot facility cost $250,000 excluding land and utilities. Finally, the personnel and operating costs will start at $100,000 annually.

A much more detailed break-out of the costs is contained in a February 1982 article from our Journal. I have enclosed a copy for your use.

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QUESTION: Your discussion on the nature and value of research includes the following points: (1) long-term research, (2) research continuity is productive, and (3) research and development tell us where to go next. The current Administration is eliminating long-term research and cutting research continuity. What further ramifications do you believe these policies will have on our ability to address future water pollution control problems?

ANSWER: Under the best circumstances there is a certain amount of "lag" in translating basic research into applied research. We are not working under the best circumstances now, but this can not be explained solely by the reduction in federal support.

Part of the explanation has to do with the program priorities that water pollution control program managers — at all levels of government — decide to set. If a certain line of investigation is not immediately applicable to those priorities, then its results will not be organized in a way that promotes efficient transfer to applied research. Our two R&D reports show that much work has been done in relative isolation. It shows further that we need to organize what we have on hand now to fuel more applied research. Thus, one answer to your question (at least as far as it deals with long-term research) is to say that we have a certain amount of catching up to do and that a lower level of support for some basic research activities will not slow us down too much.

This answer depends, however, on having the federal government continue its commitment to applied research through grants and contracts. We have a fair amount of basic research "in the bank," so to speak. Through careful management the federal government could cut back in this area without seriously harming our general capability to keep abreast of the pollution control problems that are created.

Let me illustrate this point by going back to the question of sludge recycling. Our R&D report contains many examples of innovative ways to use sludge and its constituents. But there is a gap in our knowledge of how much potential a particular alternative has, such as composting. To quote the report:

> "Compost curing is a far more complex subject than it might seem. What does it accomplish, when is it necessary, how long should one cure, is it needed for all compost substrates, does it improve the quality of the compost in economic terms, etc.? It is interesting to note that sludge materials ranging from raw sludges (with absolutely no stabilization) to digested, composted, and cured material (perhaps the maximum in the way of stabilization) are currently used. Can curing be eliminated from the composting system if some other rate limitation, such as low moisture, is used to reduce the reaction rate? If so, what maximum rate is acceptable? A great deal of money may be spent on curing systems in the future with very little knowledge as to what is really being accomplished."

This quote shows that there are a lot of very specific, very practical question that we still need to answer. Without the applied research to find answers, treatment agencies could be forced into spending thousands of dollars more than they really need to spend. If the federal government decides to cut back on this type of work and still support the construction of treatmeut facilities, it may spend too much. Does it makes sense to cut deeply into the few millions that we spend on R&D if that will result in the foolish expenditure of billions for treatment?

At this juncture let me hasten to add that I do not think that the federal government can cut its basic research budget for very long. States, municipalities, and the private sector can not take up very much of the slack. Consider the case of agricultural research as a parallel.

Today we hear a great deal about how commercial exploitation of agricultural research has done wonders for us. This is true: our economic and market systems have promoted the useful application of this knowledge faster than government ever could. But where did the money for the basic groundwork and the practical breakthroughs come from?

Not the private sector. It came from years of government funding. The water pollution control field is the same way. No one company, treatment authority, or state can afford to invest its money in basic research the way the federal government can. Since the benefits of such an investment accrue to all citizens, I believe it is appropriate that the majority of the funding for this type of work continue to come from the federal government. In hard economic times it is wise to trim our costs, but we will have hard environmental times in the future if we cut too much from the wrong areas.

Questions for J. David Thomas

1. Your statement quotes from a 1980 report by the Subcommittee on Oversight and Investigation of the House Committee on Public Works and Transportation that "... to a degree not anticipated the conventional secondary treatment technologies employed by municipalities and many industries have succeeded in removing most of the priority pollutants".

   o Based upon your research (5 plant study) how complete is this removal capacity by conventional secondary treatment?

   o What additional research is needed to clarify this situation?

2. The Chemical Manufacturers Association's 5-plant study has been hailed by industrial groups as strong evidence to support the waiving of BAT requirements for toxic pollutant control.

   o Do you share these views? Why?

   o On what basis were the five participants in the study selected?

   o How applicable are the 5-plant study's results (high percentage removal of toxic chemicals) to chemical companies utilizing similar biological treatment processes? Should additional studies of this nature be performed? Is CMA planning to do additional studies in this area?

3. Your testimony states that "inherent limitations of sampling and analytical methodologies for the organic priority pollutants must be recognized". You also state that "based on the data collected during the 5-plant study, there is no scientific reason to require additional categorical treatment for this industry."

   o If such limitations exist, how can you make such a statement?

4. What is CMA's position on reauthorization of the Clean Water Act? How do you think Congress should act in reauthorization?

5. Please provide for the record your specific views on how research and development in the water pollution control field should be organized. This information should include answers to the following questions:

   o Who should fund the research?

   o What roles should Federal, State, and local government and industry have in water pollution control research and development?

   o What issues are best studied at the Federal level? What issues are better served at the State level?

Responses to Questions for
J. David Thomas, Witness
for the Chemical Manufacturers Association,
to the Subcommittee on Natural Resources,
Agriculture Research and Environment
based on testimony given on
June 10, 1982

1.(a) The results of the Five Plant Study show that toxic pollutants are being effectively removed by current biological treatment. The removal efficiency is at least 87% removal of all toxic organic pollutants across the biological treatment system.

The following quotes and tables from the Five Plant Study report will further help answer the question.

"The performance data presented in Tables 4.2 through 4.4 are largely self-explanatory. In general, the performance data indicate that the toxic organic pollutants in all groups, with only a few exceptions, are removed by the biological treatment systems to effluent concentrations very close to or below the detection limit (10 ppb) accepted for the analytical methodologies used in this study. Of the 52 toxic organic pollutants reported in the effluents from the five participating plants (counting the four base/neutral isomeric pairs as eight compounds), 36 of the geometric mean effluent concentrations were below 10 ppb, 10 were between 10 and 50 ppb, five were between 50 and 100 ppb, and only one (pentachlorophenol at 115 ppb) was over 100 ppb concentration. As discussed in the previous evaluation of the analytical reliability of the techniques used for measurement of these pollutants, potentially great uncertainty exists that a specific toxic organic pollutant will be present and/or there is a potentially large uncertainty in measured concentrations below 100 ppb. Thus, a general conclusion which can be drawn from the performance data presented in Tables 4.2 through 4.4 is that essentially all of the toxic organic pollutants are removed effectively in biological treatment plants to average long-term effluent concentrations which are at the limit of the accuracy, repeatability, and reproducibility of the analytical methods used to determine their presence.

Several observations are warranted with respect to the performance data shown in these tables. First, it is important to note that in many if not most cases there are significantly fewer observations of a specific organic pollutant in the treated effluent than there are in the influent. Since these studies were conducted over a continuous period of time (with the exception of weekends), it can be assumed that in most cases these missing observations can be construed as meaning that essentially 100 percent of the influent loading of the particular organic pollutant was removed by the biological treatment system. This factor has not been built into the percent removal values shown in Tables 4.2 through 4.4. Second, it should be noted that many of the low percent removals occur when the influent concentration of the specific organic pollutant is very low. This, obviously, is to be expected. Finally, it is very important to note the number of observations on which the statistical analysis parameters for each pollutant are based; in many cases, particularly with respect to the treated effluent, a very small number of detections were found during the study and serve as the basis for the statistical analysis. In the case where there are a large number of influent detections for the same pollutant, it can be assumed that a pollutant showing a very small number of effluent observations is essentially totally removed by biological treatment. In the case of pollutants where a very low number of influent samples also exist, conclusions with respect to long-term treatability must be made with caution.

One effective way of aggregating the data to get an overall view of the performance of the biological treatment systems for the toxic organic pollutants is to examine the removal of the pollutants by group. Based on the log normal statistics, the removal of the volatile pollutants was highest at 95.2 percent, base/neutral pollutants are second at 87.4 percent, and the removal of the acid pollutants is the lowest at 77.3 percent. Care must be taken in generalization of these removals, however, inasmuch as the factor stated above with respect to the relationship between influent and effluent concentrations for a particular pollutant and the number of pollutants actually detected in the influent and effluent have a significant impact on these averages. The geometric average effluent concentrations for each of these groups which are volatiles, 8 ppb; base/neutrals, 15 ppb; and acids, 34 ppb; also support the generalization with respect to the relative treatability of each pollutant group."

TABLE 4.2

TREATMENT SYSTEM PERFORMANCE FOR VOLATILE COMPOUNDS

Compound	Influent			Effluent			Percent Removal
	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	
Acrylonitrile	10,300	1.902	47	65	1.877	3	99
Benzene	581	1.963	129	6	0.704	58	99
Bromomethane	1,250	1.396	9	ND	-	0	100
Bromodichloromethane	20	1.251	29	5	0.000*	9	75
Carbon tetrachloride	51	2.025	3	ND	-	0	100
Chlorobenzene	20	1.086	29	16	-	1	20
Chloroethane	12	1.755	19	5	0.000*	2	58
Chloroform	348	2.230	63	13	0.879	62	96
Dibromochloromethane	6	0.475	22	ND	-	0	100
1,1-dichloroethane	9	1.398	22	5	-	1	44
1,2-dichloroethane	524	1.252	73	9	1.031	64	98
1,1-dichloroethene	42	2.064	53	ND	-	0	100
t-1,2-dichloroethene	42	1.931	7	5	0.000*	3	38
1,2-dichloropropane	138	1.133	54	7	0.619	27	95
1,3-dichloropropene	148	1.199	47	6	0.315	19	96
Ethylbenzene	283	1.640	107	5	0.000*	25	98
Methylene chloride	17	1.529	61	9	0.893	58	47
1,1,2,2-tetrachloroethane	17	1.733	2	5	-	1	71
Tetrachloroethene	6	0.521	31	5	0.000*	3	17
1,1,1-trichloroethane	7	0.543	38	5	0.000*	19	29
1,1,2-trichloroethane	12	0.876	15	5	-	1	58
Trichloroethene	7	0.586	31	5	0.000*	19	29
Trichlorofluoromethane	ND	-	0	8	0.824	4	-
Toluene	4,500	0.809	112	7	0.788	51	100
Vinyl chloride	6	0.438	4	ND	-	0	100
All Volatile Pollutants	166	2.655	1,007	8	0.831	430	95

NOTE: ND - not detected.

*All detections were less than 10 ppb.

TABLE 4.3
TREATMENT SYSTEM PERFORMANCE FOR BASE/NEUTRAL COMPOUNDS

Compound	Influent			Effluent			
	Geometric Mean (ppb)	Standard Deviation (log$_e$ scale)	Number of Detections	Geometric Mean (ppb)	Standard Deviation (log$_e$ scale)	Number of Detections	Percent Removal
Acenaphthene	84	0.611	9	5	0.000*	2	94
Acenaphthylene**	65	0.514	10	5	0.000*	3	92
Anthracene[1]/ Phenanthrene[1]	62	1.655	14	6	0.449	6	90
Benzo(a)anthracene[2]/ Chrysene[2]	20	1.027	10	8	1.111	6	60
Benzo(b)fluoranthene[3]/ Benzo(k)fluoranthene[3]	11	0.979	10	11	1.112	7	0
Benzo(a)pyrene	13	0.953	11	18	1.814	2	-
Bis(2-ethylhexyl)phthalate	24	2.070	47	28	1.382	44	-
Butylbenzylphthalate**	12	1.529	5	5	-	1	58
Chrysene	ND	-	0	5	-	1	-
Dibenzo(a,h)anthracene	15	-	1	75	-	1	-
Di-n-butylphthalate	86	2.098	44	6	0.762	24	93
1,3-dichlorobenzene[4]/ 1,4-dichlorobenzene[4]	5	-	1	ND	-	0	100
1,2-dichlorobenzene	331	1.354	43	29	1.105	17	92
Diethylphthalate**	134	1.964	36	9	0.693	19	93
Dimethylphthalate	46	2.011	31	5	0.000*	8	89
Dioctylphthalate	28	1.117	6	5	0.000*	3	82
Fluoranthene	17	1.347	19	6	0.577	7	65
Fluorene	56	0.693	10	5	-	1	91
Isophorone	650	-	1	ND	-	0	100
Naphthalene	802	1.930	11	6	0.460	5	99
Nitrobenzene	3,000	2.010	32	91	1.775	2	97
Pyrene	17	1.357	19	6	0.496	10	65
1,2,4-trichlorobenzene**	234	1.026	46	39	1.097	39	83
All Base/Neutral Pollutants	119	2.157	416	15	1.271	208	87

[1,2,3,4] Reported as isomer pairs.

NOTE: ND - not detected.

*All detections were less than 10 ppb.

**Note: There was some question in the proper identification of these compounds in some of the samples, based on the following information:

(1) 1,2,4-trichlorobenzene – most likely the co-isomer, 2,4,6-trichlorobenzene, which is not on the priority pollutant list.
(2) Diethylphthalate – interference with dimethyl nitroaniline which coelutes with the phthalate ester.
(3) Acenaphthylene – interference with dichloroaniline or biphenyl which coelutes with acenaphtylene.
(4) Butylbenzylphthalate – most likely a product from a manufacturing process and not the phthalate ester.

TABLE 4.4

TREATMENT SYSTEM PERFORMANCE FOR ACID COMPOUNDS

	Influent			Effluent			
Compound	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	Percent Removal
4-chloro-3-methylphenol	ND	-	0	8	0.676	2	-
2-chlorophenol	53	1.183	57	35	1.085	23	34
2,4-dichlorophenol	347	0.765	43	24	1.062	33	93
2,4-dimethylphenol	270	1.992	12	5	0.000*	8	98
2,4-dinitrophenol	673	1.247	44	59	1.645	6	91
2-nitrophenol	40	0.628	38	9	0.634	4	78
Pentachlorophenol	216	1.330	49	115	1.462	57	47
Phenol	171	1.820	137	10	0.976	55	94
2,4,6-trichlorophenol	100	1.210	89	53	1.242	72	47
All Acid Pollutants	150	1.586	469	34	1.503	260	77

NOTE: ND - not detected.

*All detections were less than 10 ppb.

In addition, the Five Plant Study compares the results of this study to other similar studies. The following quote and table also help answer this question.

"An extensive study was conducted by the Municipal Environmental Research Laboratory (MERL) of EPA in Cincinnati, Ohio, into the biodegradability and rate of acclimation of biological cultures for 96 toxic organic pollutants. This study was based on the use of a static-culture-flask biodegradation screening technology which made it possible to evaluate the biodegradability of each of the pollutants tested at two concentrations (5 and 10 mg/l) by wastewater microbiota using culture enrichment techniques. A number of the pollutants analyzed in this EPA study were present in the influents and effluents of the participants in the five-plant study. Table 6.3 presents a comparison of the results of the biodegradability testing conducted by the MERL and the results of the five-plant study. The MERL study involved, as discussed above, the use of two concentrations of the toxic organic pollutant and four separate phases of biological cultural enrichment. For the purposes of the comparison in Table 6.3, the percent degradation observed by EPA in the third subculture at the 5 mg/l concentration was used. The reason for selecting the 5 mg/l concentration is that this more closely approached the concentrations observed in the influents to the treatment systems participating in the five-plant study. As can be seen by reviewing the data presented in Table 6.3, there is generally close comparison between the results of the five-plant study and EPA's estimate of the biodegradability of the toxic organic pollutants. In most cases where there is a significant difference between the calculated percent removal from the five-plant study and EPA's estimated biodegradability, it is due to the fact that the influent concentration observed during the five-plant study was less than 40 ppb, which is approaching the effective detection limit of the analytical methods used. It also should be pointed out that EPA states that the analytical method which was used in this biodegradation testing had an effective limit of detection of 100 ppb, considerably above the detection limit attained by the laboratories participating in the five-plant study. Thus, essentially all of the percent removals below 90 shown for the five-plant study probably would have been shown as a 100 percent removal by MERL's biodegradability test.

The EPA MERL study indicates that the majority of the priority pollutants are biodegradable and is confirmed by the findings of the five-plant study. Comparison of these two data bases, both of which are extensive and well documented, leads to the conclusion that the majority of these pollutants are biodegradable and a well designed and well operated biological treatment system is effective in their removal to concentrations which are below detection limits or are near the limit of determinability."

TABLE 6.3

COMPARISON OF BIODEGRADABILITY OF TOXIC ORGANIC POLLUTANTS AS PREDICTED BY EPA MERL STUDY TO THE FIVE-PLANT STUDY RESULTS (Ref. 6.5)

Volatile Compound	EPA Percent Degradation	Five-Plant Study Percent Removal**	Base/Neutral Compound	EPA Percent Degradation	Five-Plant Study Percent Removal**	Acid Compound	EPA Percent Degradation	Five-Plant Study Percent Removal**
Acrylonitrile	100	99	Acenaphthene	100	95	2-chlorophenol	100	41
Benzene	100	100	Acenaphthylene	98	93	2,4-dichlorophenol	100	91
Bromomethane	48	100	Anthracene	92	97	2,4-dimethylphenol	100	100
Bromodichloromethane	67	89	Benzo(a)anthracene	35	56***	2,4-dinitrophenol	100	84
Carbon tetrachloride	100	100	Benzo(b)fluoranthene	100	- ***	2-nitrophenol	100	77
Chlorobenzene	100	56***	Benzo(a)pyrene	NA	- ***	Pentachlorophenol	100	36
Chloroethane	NA	91	Bis(2-ethylhexyl)phthalate	95	64	Phenol	100	98
Chloroform	100	99	Butylbenzylphthalate	100	87***	2,4,6-trichlorophenol	100	45
Dibromochloromethane	55	100	Dibenzo(a,h)anthracene	NA	- ***			
1,1-dichloroethane	100	79***	Di-n-butylphthalate	100	99			
1,2-dichloroethane	100	99	1,3-dichlorobenzene	35	100***			
1,1-dichloroethene	100	100	1,2-dichlorobenzene	29	94			
t-1,2-dichloroethene	100	98	Diethylphthalate	100	99			
1,2-dichloropropane	92	97	Dimethylphthalate	100	99			
1,3-dichloropropene	100	96	Dioctylphthalate	94	90			
Ethylbenzene	100	99	Fluoranthene	100	83***			
Methylene chloride	100	75	Fluorene	77	93			
1,1,2,2-tetrachloroethane	36	93	Isophorone	100	100			
Tetrachloroethene	100	27***	Naphthalene	100	100			
1,1,1-trichloroethane	100	38***	Nitrobenzene	100	98			
1,1,2-trichloroethane	59	72***	Pyrene	100	84***			
Trichloroethene	100	40***	1,2,4-trichlorobenzene	24	82			
Toluene	100	100						
Vinyl chloride	NA†	100						

*Includes volatilization losses at 25°C and initial concentration of 5 mg/l.

**Based on arithmetic means.

***Influent concentration less than 40 ppb.

†NA = not available.

(b) In reference to the Five Plant Study, we feel the fate of the priority pollutants (air-stripping, absorption onto sludge, biodegrade) in the treatment system could be further studied. Also, performance of other types of biological treatment systems (extended aeration, aerated lagoons), compared to activated sludge needs to be documented.

2.(a) We feel the study results support case-by-case BAT determinations.

(b) The five participants were nominated by EPA based on the expected occurrence of priority pollutants identified as typical of this industry during previous EPA studies. EPA attempted to cover all the major toxic organic pollutants in the chemical industry. The results show that 100% of the major toxic organic pollutants were covered in the study.

(c) We believe the study results are applicable to the entire chemical industry that uses biological treatment-activated sludge. Currently 80% of the entire chemical industry uses activated sludge treatment. Further study needs to document the effeciency of other biological treatment systems.

3. This statement can be made because a single sample may yield uncertain results; however, the Five Plant Study used a large number of data points (long-term data) so that the averages represent a long-term result which is statistically more acceptable. Thus the long-term average values may be used to reach valid conclusions.

4.(a) Please refer back to CMA's June 10, 1982 testimony before your subcommittee.

(b) In reauthorization of the Clean Water Act, we feel Congress should take a comprehensive review of the Act addressing the concerns raised in the CMA written testimony of June 10, 1982.

5.(a) Research needs of the Clean Water Act should be funded by the federal, state, local and private sector. In general, the funding should be determined by the interest and anticipated benefit to the specific group.

(b) Each group (federal, state, local governments, and the private sector) has an important role to play in funding further research needs of the Clean Water Act. Each has key areas of competence, knowledge and particular areas of interest. The important thing is that the research of each group should be complementary and not duplicative of other groups.

(c) The federal level would be more effective to study R & D with national or universal applicability, e.g.:

1. Toxicity of various materials to selected organisms
2. Efficy of model treatment technologies
3. Development of waterbody allocation models.

The state level would be more effective to study R & D with limited applicability to that state or region, e.g.:

1. Biological or chemical composition of a particular waterbody
2. Modeling a specific waterbody for allocation
3. Efficy of a treatment technology to a specific waste stream

Questions for Dr. Cecil Lue-Hing

1. Your statement mentions that the Association of Metropolitan Sewerage Agencies welcomes shifting waste water pollution control programs to state and local governments but, they are disappointed by the reduction in federal research and development support.

   - Why does AMSA welcome this emphasis on local control?

   - What specific examples can you give that prove federal research and development support is necessary for local implementation of wastewater pollution control programs?

2. Your testimony states that additional research is needed in the area of more efficient toxic chemical removal by current municipal wastewater treatment practices. Specifically what kinds of research needs to be performed to determine the degree of toxic chemical removal by municipal treatment?

3. Recent studies by EPA and the Chemical Manufacturers Association suggest that biological treatment of toxic chemical containing wastewaters removes high percentages of these contaminants. Do you believe this justifies elimination or relaxation of pretreatment or BAT requirements for indirect industrial dischargers? What type and kind of research will provide us with answers to these questions?

RESPONSES
to
ADDITIONAL QUESTIONS
by
CHAIRMAN JAMES H. SCHEUER
SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT

following

TESTIMONY ON JUNE 10, 1982

1. "Your statement mentions that the Association of Metropolitan Sewerage Agencies welcomes shifting wastewater pollution control programs to state and local governments but they are disappointed by the reduction in Federal research and development support."

   a. "Why does AMSA welcome this emphasis on local control?"

AMSA has always endorsed the concept that a local municipal agency should be allowed to operate its own pretreatment program independent of the categorical standards being set by the USEPA, provided that the local program meets the national environmental protection objectives. To this end, AMSA has recommended to the USEPA that legislative modification of the Clean Water Act be pursued to allow this flexibility.

The best type of industrial waste control system for a particular community is often determined by characteristics or circumstances unique to that community's water pollution control needs and cannot be dictated by administrative fiat.

Under the present system, pretreatment focuses primarily on enforcement of National Categorical industry standards. Application of this concept will result in a local agency having to enforce different limits for the same pollutant for various industries or even for different companies within an industry which may be treated in the jurisdiction of the local agency. Surveillance and enforcement of multiple standards for a specific pollutant represents a most costly and ineffective approach to controlling this specific pollutant.

National Categorical Standards fail to take into account local conditions of sewerage treatment plant design, existing ordinances, and differences in local receiving waters and thus AMSA has encouraged local development and enforcement of pretreatment programs. The national program should only be applied where POTWs are either unwilling or unable to control the indiscriminate discharge of industrial wastes into their systems.

Needless to say, the issue of reduced Federal support for non-Research and Development functions is injurious to the objective of the Clean Water Act, regardless of whether these programs are controlled at the Federal, state or local level.

b. "What specific examples can you give that prove Federal research and development support is necessary for local implementation of wastewater pollution control programs?"

EXAMPLES

There is a need for developing a more reliable data base on the concentration levels of industrial pollutants which have been declared to be toxic, and which are not completely removed by municipal waste treatment systems.

More reliable information is needed on the effects of these pollutants.

More reliable information is needed on the fate and distribution of these pollutants in the environment.

There is a need to develop new reliable methodologies for identification and quantification of these pollutants.

There is a need to develop more reliable information on the environment effects these pollutants when they are disposed of as components of municipal sludges.

One of the keys to developing an effective local pretreatment program is information regarding the effects of a particular pollutant on the municipal treatment system and the receiving waters to which the pollutant may eventually be discharged. In regard to the various organic compounds which have been declared to be toxic, there is little information on the levels of concern, their effects, and fate in the environment.

The analytical methodologies for the organic toxicants presently available have a great degree of uncertainty in terms of accuracy, reliability, and reproducibility. As was reported in the study conducted by the Chemical Manufacturer's Association (CMA/EPA Five Plant Study, Engineering-Science, Inc., Austin, Texas, April, 1982), if a volatile organic pollutant were measured in a single analysis as 100 ppb, a second analysis of that same sample could yield a result as low as 20 ppb or as high as 500 ppb. This makes determination of compliance or noncompliance with a prescribed limit very difficult. In addition, these methodologies are extremely expensive and require highly skilled personnel which may prohibit a smaller municipal agency from conducting the necessary monitoring.

Without a concerted effort on the part of the USEPA to further refine and develop methodologies for more accurate and reproducible organic pollutant analysis and more information on the fate and harmful levels of these organics, municipalities will not be able to carry out an equitable and cost-effective local pretreatment program. It is simply infeasible for local municipalities to develop this information on their own given the high cost of the Research and Development required for toxic organic studies.

As it is well known, public acceptance is a key to implementation of local wastewater treatment and sludge management programs. Often, the public has legitimate questions concerning the environmental effects of local wastewater treatment and sludge management programs. Local agencies must have access to information on the environmental effects of the various wastewater treatment and sludge management options available if they are to address these concerns of the public. Without this information, local agencies may be forced to adopt programs simply because they are the ones for which adequate environmental impact research has been done. Local agencies simply do not have the resources to conduct the research required on the many options available and this information should logically be gathered by the USEPA.

Further, the generation or the development of information as noted above through proper research will promote more effective use of municipal wastewater treatment systems already paid for by Federal and local funds in the management of these toxic pollutants. Additional benefits will include:

a. Fewer satellite industrial pretreatment systems,

b. Fewer sites for the generation of industrial sludges, and

c. Lower costs for local wastewater treatment agencies to monitor and enforce against industrial pretreatment installations.

Finally the availability of the information as noted would permit more reliable and rapid determination by local agencies relative to the impact perspective industrial dischargers may have on local wastewater treatment systems.

2. "Specifically what kinds of research needs to be performed to determine the degree of toxic chemical removal by municipal treatment?"

There is some data available from a USEPA study to determine the fate of the priority pollutants in publicly owned treatment works (POTWs) which indicates that biological treatment is effective in reducing these pollutants present in wastewater influent to municipal treatment plants. (Feiler, H., "Fate of Priority Pollutants in Publicly Owned Treatment Works--Interim Report," USEPA, EPA 440/1-80-301, October, 1980.) However, the concentrations found in the municipal influents were often less than the detection methods employed, 10 ppb. In view of the present analytical uncertainty for organic toxic pollutants, the actual prediction of removals for a given treatment situation cannot be reliably determined from this study.

SPECIFIC RESEARCH NEEDS

a. Research is needed on improved analytical methodologies in terms of accuracy and reproducibility.

b. Also needed are more simplified and less costly procedures, which could be performed on a routine basis.

c. There is the need for additional studies as to occurrence, distribution, and fate of the organic pollutants in municipal wastewater treatment systems under varying operating conditions, especially during different seasons of the year.

3. "Recent studies by EPA and the Chemical Manufactures Association suggest that biological treatment of toxic chemical-containing wastewaters removes high percentages of these contaminants. Do you believe this justifies elimination or relaxation of pretreatment or BAT requirements for indirect industrial dischargers? What type and kind of research will provide us with answers to these questions?"

The fact that biological treatment systems, such as municipal secondary treatment systems, remove toxic organic constituents does not in itself preclude the need for pretreatment by indirect industrial dischargers. It does indicate that some degree of treatment less than what may eventually be set as National Categorical standards would be reasonable on a local basis. Simply translated, this means that relaxation from BAT technology-based standards is appropriate. This is assuming that such standards would be set based upon performance of a well operated activated sludge system, similar to these presented in the CMA study (CMA/EPA Five Plant Study," Engineering-Science, Inc., Austin, Texas, April, 1982). It must be noted that the activated sludge systems reported upon in the CMA study had hydraulic retention times of approximately 1 to 3.4 days (Table 2.3, page 2-13) which are considerably longer than secondary treatment systems which are employed by municipal treatment plants (generally 6 to 8 hours).

The type of research required to provide answers to the questions you pose is the same as that required to establish the limits for specific organic compounds which would be acceptable for discharge to the environment. This research would involve:

(1) Development of analytical methodologies with improved accuracy and reproducibility,

(2) More detailed surveys of specific municipal treatment plants to establish occurrence,

(3) Removals and possible build-up of organic constituents in resulting waste treatment sludges, and

(4) Acceptable levels of toxic organics for discharge to various types of receiving waters.

Questions for Mr. Italo Carcich

1. Your testimony mentions that "basic research should be funded and carried out at the Federal level and applied research be conducted by the environmental expertise located within state and interstate agencies." Do you feel this research "partnership" exists under the present EPA administration? Do you feel that this situation will improve in FY 83 and FY 84?

2. One of the research areas mentioned in your statement is "the need for improved, demonstrated processes for the removal of toxic pollutants from industrial discharges by pretreatment or treatment processes." Has your Bureau of Water Research performed any research in this area? If so, what are the conclusions?

3. You have mentioned the need for improved sampling, monitoring, and analytical techniques regarding water pollution by toxic chemicals. What specific recommendations do you have in these areas?

4. To what extent are non-point pollution problems contributing to the total water pollution problem in New York State? What research and abatement procedures has the Department of Environmental Conservation used to reduce and control non-point pollution?

5. Please provide for the record an analysis of the States' ability to continue with effective water pollution control programs if the proposed reductions of Section 106 funds for FY 1983 become reality.

Answers to questions for Mr. Italo Carcich from Mr. James H. Scheuer

1. The research partnership did exist in the past and still exists but to a lesser degree during the current fiscal year. Basic research is being funded at the federal level with an oversight role being provided by EPA. At the same time, some funds for applied research are being provided to states. This can be seen by such programs as the National Urban Runoff Programs, the Clean Lakes Diagnostic-Feasibility (Phase I) Studies, and the Model Implementation Programs for Agricultural Runoff. What is disturbing is the fact that a much smaller percentage of the total research effort is being allocated to the states. Implementations of new programs are based on an effective research and development effort, and on an accurate and reliable scientific data base. This effort can be successfully achieved only when an effective partnership exists between EPA and the states. Current funding trends for Fiscal 83 and 84 do not seem to favor this partnership.

2. The Bureau of Water Research within the Department of Environmental Conservation has not performed any research on controlling or removing toxic pollutants from industrial discharges by pretreatment or treatment processes. It is an area that requires expertise that is not presently available to most states, and an area that should be addressed by EPA in partnership with industry, due to the national importance of such a program. Technical evaluations of this issue have been published by EPA in such reports as "Fate of Priority Pollutants in Publicly Owned Treatment Works", EPA Report No. 440/1-80-301, October 1980. The report confirms that even though biological treatment is somewhat effective, much still needs to be learned on the removal of organic pollutants. For instance, chlorine disinfection has a tendency to increase priority pollutant chlorinated hydrocarbons. It is for this and many other technical reasons that this issue "must" be addressed at the national level, with both EPA and industry playing an active role.

3. There is a need to establish standard analytical methodologies for most of the priority pollutants. Interlaboratory reproducibility is difficult to obtain when dealing with organic pollutants. Very extensive quality control/quality assurance programs need to be established at the state level since the accuracy of the analytical results begin with the collection of the sample.

   In view of funding limitations and increased cost of organic pollutant analyses, monitoring programs need to be very carefully evaluated in order to be effective. There is a need to increase the precision and accuracy of the data that is presently being gathered as part of our monitoring and surveillance programs. This can only be accomplished by pursuing a much more aggressive quality control/quality assurance program and standardization of analytical methodologies.

4. New York State has had a history of controlling the major municipal and industrial discharges which previously caused major water quality problems, such as, dissolved oxygen depletion, fiskills and bacterial contamination of surface waters. With most of these major discharges controlled, the runoff from agricultural and developed areas (both recreational and urban) have been implicated in being the major source of plant nutrients, suspended sediment and pesticides to both surface and groundwater. Although the non-point source discharges are lesser in magnitude than the previously uncontrolled point sources, they still presently constitute a major problem.

   NYSDEC has conducted studies of the agricultural runoff on the Genesee and Delaware Rivers and has studied the impacts of urban runoff at Rochester, NY, Long Island, and at Lake George. These studies have primarily consisted of estimating the loadings of contaminants and subsequent water quality impacts. To date, the lack of any Federal support has precluded evaluating measures for controlling non-point source pollution.

Answer to question 5

STATEMENTS

June 21, 1982

THE STATE'S
Water Quality Fact Sheet

IMPACT OF NO CONSTRUCTION GRANTS APPROPRIATION FOR FISCAL YEAR 1982

The Urgent Supplemental Appropriation for Fiscal Year (FY) 82 is currently under consideration by the Congress (H.R.5922). It includes $2.4 Billion for municipal waste water treatment construction grants among many other items of interest. President Reagan withheld the FY82 budget request for the program pending passage of satisfactory reform legislation. Due to delays in passage of the required amendments to the Clean Water Act, the FY82 Urgent Supplemental became the appropriate vehicle to respond to the Presidential request of $2.4 Billion.

Recent problems in securing the Urgent Supplemental Appropriation necessiate some examination of the potential impact on the Clean Water Act program if the FY82 appropriation is not forthcoming. This paper highlights the ASIWPCA's analysis of some of those impacts and is intended to be illustrative of the situation in all the 50 States.

Summary

The impacts of no FY82 appropriation for the Construction Grants Program go far beyond the prolonged delay in the construction of municipal sewage treatment plants to the very heart and principles of the Clean Water Act:

- Delegation of program management as called for under the New Federalism and the Act will be jeopardized.
- Mandated water quality standards requirements will go unmet.
- Public health and environmental emergencies will continue unabated.
- The gap between cleanup progress in the industrial and municipal sector will widen, seriously undermining the State's ability to have an equitable program for control of toxic and conventional pollutants.
- Public expectations (and support) for a strong National commitment to clean water will be detrimentally affected.

The Clean Water Act program requirements depend on several inter-related funding sources in the Act. The construction grants appropriation, for example, funds many activities in addition to simply construction of municipal facilities. These activities stem from requirements in the law which continue to apply despite no funding. This will put States in a very awkward position. Specifically:

- State Delegation -- Section 205(g) provides that 4% of the authorized funding level (or $96 Million of a $2.4 Billion appropriation) be set aside for the States to operate the Federally mandated construction grants program under delegation. 44 States currently have the delegation. Corresponding reductions have been made in USEPA resources to reflect this.

- Water Quality Based Program -- Section 205(j) provides that 1% of the authorized funding level (or $24 Million of a $2.4 Billion appropriation) be set aside for developing water quality based requirements. This new set aside under the 1981 Amendments is intended to focus the program on critical water quality problems and is targetted by the Administration for revising water quality standards. No construction grant can be issued for a facility unless the review required under the Act is completed. If there is no construction grants appropriation in FY82, there will be at least one year slippage in the Act's required schedule of completion. There is no flexibility provided in the statute for this eventuality.

- Municipal Construction -- The remaining funds in the construction grants appropriation under Title II of the Act (i.e. minus a 4% set aside for State delegation and a 1% set aside for water quality based program planning) are intended for the construction of municipal sewage treatment plants. The 1981 Amendments placed increased emphasis on targetting those funds toward priority water quality problems. If there is no FY82 appropriation

  - there will be adverse impacts on water quality and employment

  - the intricate transition contemplated under the 1981 Amendments toward changed eligibilities and a reduced Federal share is predicated on a sustained appropriations level of $2.4 Billion. Consequently, the reforms passed will be placed in serious jeopardy.

  - Local communities who have made financial commitments based on Federal assurances of an FY82 appropriation will experience serious difficulties in meeting their obligations financially and legally under the Act and court orders/consent decrees.

- State Management Grants -- Section 106 baseline water program support will be adversely affected if there is no FY82 appropriation. Federal requirements, intended under the Act to be supported by Section 205(g) and (j), will place severe strains on the already overburdened State Management resources. Delegation permitting, compliance, enforcement, construction grants, water quality standards, and monitoring requirements of the statute will compete for continued support. Yet, these requirements will continue to demand the same level of attention as in previous years. In fact, with the decrease of Federal funding and personnel support if there is no FY82 construction grants appropriation, demands on State resources will increase. Permitting delays for industry and municipalities will delay capital investment just at the time when economic recovery is most urgent.

It is important to note that the Administration's proposed 20% reduction in Section 106 funding in the FY83 budget and in the reauthorization of the Clean Water Act is predicated on a construction grants appropriation at the $2.4 Billion level to offset the reduction.

Please consult the attached issue papers for further discussion and examples. The issues covered include:

I. States which have depleted their construction grants funds.

II. Project disruption and delayed completion.

III. Implication of no FY82 appropriation on the Bond Market and local financial commitments.

IV. Public health needs and the economy -- local dependency on the Federal commitment.

V. Outlook for continued State ability to assume delegation of the management of the Federal construction grants program.

VI. The beneficial impact of the construction grants program on employment.

VII. The inflationary costs of delay.

VIII. Toxic and water quality standards requirements of the Clean Water Act depend on the availability of a FY82 construction grant appropriation.

Part I

Issue: States which have depleted their construction grants funds.

Problem: Most States have expended their construction grants allotment. Because that occurred earlier in the 1981 Fiscal Year, the construction grants program has come to a virtual halt for new projects. The implications on achieving the requirements of the Clean Water Act, abating public health emergencies, court orders, and financial commitments are substantial.

Examples: Over 37 States are virtually out of construction grants funding:

Connecticut
Maine
Massachusetts
New Hampshire
Vermont
New Jersey
New York
Pennsylvania
Virginia
Alabama
Florida
Georgia
Kentucky
Mississippi
North Carolina
South Carolina
Tennessee
Illinois
Arkansas
Louisiana
New Mexico
Texas
Iowa
Kansas
Missouri
Nebraska
Colorado
South Dakota
Utah
Wyoming
Arizona
California
American Samoa
NMI
Idaho
Oregon
Washington

New York expects $1.3 Billion over the period of the authorization period in the 1981 Amendments. If there is no FY82 appropriation they will fall further behind in terms of water quality and meeting the requirements of the Act for construction and water quality based planning and standards:

- $3.2 Billion will be required to complete the projects now in Federal program.
- $2.3 Billion will be required to complete those projects now under construction.

In Georgia 8 projects are ready and waiting to move forward at this time-- with $55 Million in grant funding needed. Total cost of the projects is $73.5 million. With less than $1 Million in an unobligated balance for the State, all project work is at a standstill except for routine grant increases.

Competition between large and small cities and townships is going to increase if there is no FY82 appropriation. A survey by the Association of Metropolitan Sewerage Authorities (i.e. the larger cities) estimates approximately 193 large municipal treatment projects could use more than $2.66 Billion -- i.e. $260 Million more than provided in the FY82 Supplemental. This is before any consideration of the needs of smaller municipalities and rural communities. As the gap between"projects ready to go" and available appropriations grows with no FY82 funding, it is going to be increasingly difficult to equitably distribute funding on a water quality basis.

Part II

Issue: Project disruption and delayed completion

Problem: Large projects frequently must be constructed in phases or segments. Over 250 such projects are currently underway nationally. Delay not only jeopardizes completion of these projects but increases costs due to inflation. The 1981 Amendments to the Clean Water Act establish a transition period in the reform of the program. Successful completion of that transition depends directly on maintaining a level of $2.4 Billion in appropriations into the outyears.

Examples: Nationally $8.75 Billion will be required to complete those phased and segmented projects under construction and to receive a return on the taxpayers investment, ie. clean water. No appropriation in FY82 will be a serious setback to achieving compliance with the deadlines in the Clean Water Act.

In New York $2.3 Billion is needed over the next 4 years just to complete projects under construction. This exceeds their expected allotment by $1 Billion. No appropriation in FY82 will exacerbate the situation leading to delayed compliance and continued violations of water quality standards.

The State of Georgia has attempted to phase and segment projects whenever feasible to distribute as widely and equitably as possible the limited available funds. In doing this, Georgia tried to see that each section of a project constituted an operable portion of a treatment works, as consistent with EPA requirements. Several projects have a previous grant of which a phase is under construction. For these, Georgia needs FY82 monies to bring these communities into compliance with the law.

Part III

Issue: Implication of no FY82 appropriation on the Bond Market and local financial commitments.

Problem: In anticipation of the Federal commitment to appropriate $2.4 Billion to the program in FY82, local communities made financial commitments. Such action is benefical to the program in several ways: it assures minimum delay in construction starts once the appropriation becomes available, and it assures local communities can keep up with the tight transition period anticipated under the 1981 Amendments. Sloppy schedules can literally cost local communities millions of dollars unnecessarily when Federal eligibilities and matching requirements change in FY84. Perhaps most importantly the dim outlook on funding in FY82 tarnishes the credibility of the Clean Water Act programs in the eyes of local communities and Wall Street.

Examples: In Georgia local officials have already made arrangements for their 25% matching share and have either procured the bonds (e.g. Atlanta) and are now being forced to pay the debt service with no commensurate benefit to the community, or they have made those arrangements to move ahead. If there is no FY82 money, these communities may not be able to meet their existing financial commitments and may have to withdraw from the process. There is a substantial risk to State bond ratings should a community have to default.

Bond companies are getting smarter and more conservative each day. Because faith in the Federal Government's ability to meet its commitment to the construction grants program is dubious at best, there is an emerging trend in Bonding Establishments to take a community through the entire paper process resulting in a binding arrangement -- i.e. receiving a bond rating, establishing payment schedules, and the like. Yet the Bonding Establishment falls short of funding the project until the Federal appropriation has been secured. Examples include:

- Waycross, GA
- La Grange, GA
- Rome, GA
- Dalton, GA

Part IV

Issue: Public health needs and the economy -- Local dependency on the Federal commitment

Problem: It will be increasingly difficult to meet the public's demand for clean water and the requirements of the Act if the Federal Government cannot meet its commitment to appropriate $2.4 Billion in FY82. Perspectives differ given the situation of the 50 State economies. Things that at one time seemed critical may not be as critical in a State whose economy is flat on its back.

Example: Oregon has 3 Severe Health Hazard Projects which must be dealt with immediately. Stream pollution and water degradation, along with direct contact with raw sewage health hazards are the biggest issues in Oregon. These projects are critical to the health and well being of the people of Oregon. Because Oregon's remaining problems are generally "poverty pockets", these communities would find it is financially impossible to do without Federal funding support:

- Roseburg
- Klamath Falls--Litigation
- Monroe

Silverton and Cottage Grove have voted bond support and are ready to move forward which would bring much needed employment to these rural areas. Both now discharge raw sewage into the stream, thus there is significant health and recreational use impairment in downstream areas. What this means is that our poorest children play in open sewers and are exposed to disease on a regular basis.

At the other end of this continuum, of course, are the outyears--i.e. FY85 and beyond. The delay of FY82 projects will force reevaluation and revision of projects currently in the funding schedules because of the FY81 Amendment changes to project eligibilities and local funding share. Most outyear projects in Oregon will not be able to obtain a 45% share as required by FY84--at least 8 projects will be in this category.

Nationally a survey by the National Governors' Association indicates only 3 States report a favorable outlook for offsetting to some degree a reduction in Federal support.

In Utah, the 2 projects in the Salt Lake City area are a high water quality priority. They will require over $110 Million and are the culimination of more than 10 years of planning and design work. The currently inadequate treatment facilities present a threat to public health and water quality. Further degradation with increased growth in the area raises the potential of building moratoriums. Since the area will serve 43% of the States population, a failure in the Federal appropriations process will have very serious impacts.

In New Jersey, a failure in the Federal appropriations process translates to the continued endangerment of the population being subjected to public health hazards. People have been forced to leave their homes because of failing septic systems. Overloaded sewage treatment plants are causing overflows out of manholes into the nearest stream. Documented cases of hepatitis in children have resulted. New Jersey has an unpopular system for limiting such problems -- i.e. building bans as a last resort. These are neither an effective way to achieve the requirements of the Act nor in the best interests of the nation's economy.

Economic revitalization in Georgia is dependent upon a construction grants appropriation:

- Hinesville/Fort Stewart facility will serve the needs of a military build-up area. The facility is critical to the needs of the Army installation which is expected to increase the population in the area several times over.
- Atlanta intercity revitalization efforts will be severely hampered if FY82 monies are not available soon. $117 Million has already been invested in the Three Rivers Project, with an additional $40 Million for the local match ties up. This project is critically tied to Atlanta's Rehabilitation and Revitalization Plan.

Part V

Issue: Outlook for continued State ability to assume delegation of the management of the Federal construction grants program

Problem: Congress, under Section 205(g) of the Clean Water Act, provided for delegation of the management responsibility to the States. Funding for State management under delegation comes out of the construction grants appropriation. 205(g) is 4% of the appropriation. If there is no appropriation, delegation is in serious jeopardy now in several States. If there is no appropriation in FY82, return of the delegated functions will probably be unavoidable. Unfortunately, EPA does not have the resources to administer the program. The net effect is that stewardship of the taxpayers investment in pollution abatement will be impossible to ensure.

Examples: California is projected to run out of 205(g) funds and will begin to lay off State staff this summer.

Georgia and Arizona will be in a similar situation in late summer unless there is an FY82 appropriation.

Part VI

Issue: The benefical impact of the construction grants program on employment.

Problem: The delayed appropriation has detrimentally affected the construction industry and related trades at a time when the economy is suffering from high unemployment. If there is no appropriation for construction grants in FY82 the depressed construction trades will be further affected. Projects will be halted; new starts will be impossible.

Examples:

- Nationally, $2.4 Billion in Federal funding at a 75% Federal share will inject a total of $3.2 Billion into construction of sewage treatment plants. This will generate over 100,000 workyears annually in the construction and related trades and industries.
- The Georgia Utility Contractors Association estimates a loss of more than 3,000 jobs statewide if FY82 money is not appropriated.

Atlanta	--------	$ 5.0 Million grant
La Grange	--------	$13.8 Million grant
Dalton (One of the largest Land Application Projects in the country)	--------	$14.4 Million grant
Augusta	--------	$13.1 Million grant
Macon	--------	$10.0 Million grant

Part VII

Issue: Inflationary costs of delay

Problem: The failure to secure an FY82 appropriation will result in substantial inflation costs to the Federal Government and local communities.

Examples: Nationally, assuming a minimum inflation factor of 10%, no appropriation will increase the cost of construction by approximately $320 Million. It is going to be extremely difficult for local communities to offset those costs without even further construction delays and prolonged noncompliance.

In Utah the inflationary cost increase, if there is no FY82 appropriation, for the two Salt Lake City projects which have just recently gone into construction for the first segments, exceeds the State's annual allotment under a $2.4 Billion appropriation.

Part VIII

Issue: Toxic and water quality standards requirements of the Clean Water Act depend on the availability of an FY82 Construction Grants appropriation.

Problem: Section 106 funding which has remained static over the past several years has been inadequate to satisfy the ever expanding requirements of the Clean Water Act. This is particularly a serious concern in the areas of toxics, the development of cost-effective sewage treatment plants, and affordable water quality standards. The recent 1981 Amendments placed more requirements in these areas on State and local governments and provided the funding through 205(j), which is 1 % of the construction grants appropriation, for that purpose. If there is no FY82 construction grants appropriation water quality standards, toxics studies, and sewage treatment plant construction will suffer. Specifically:

- States will be unable to undertake the kind of toxics studies necessary to develop appropriate control requirements for municipalities and industry. Very little of such information exists to date. It is absolutely imperative for a rational, justifiable national toxics management strategy.
- The Act's requirement that all water quality standards be revised in three years (or related projects cannot receive funding) will not be met.

Examples: The ASIWPCA estimated that over $25 Million nationally in additional funding will be required to factor toxics into the water quality management program at the State level. The Water Program by the nature of the medium is complex in dealing with toxics (e.g. monitoring). 205(j) funding would be adequate for that purpose. With such support the States could assure cost effective investments in toxic pollution abatement. It is projected the return on this investment at the industrial and municipal level would be many fold.

No new project starts could be undertaken in any State unless the new complex review requirements of the USEPA could be satisfied in the water quality standards program. This is over and above the past resource requirements in the program. The availability of such resources is highly questionable unless existing activities are cut. The recent survey by the National Governors' Association indicates that NPDES compliance and monitoring activities would be the most likely to be cutback to accomodate the required standards activities. This is of course counterproductive in achieving the requirements of the Act. If there is no appropriation in FY82, States will be placed between a rock and a hard place in trying to live up to their obligations and public expectations of environmental protection.

APPENDIX II

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

FROM THE OFFICE OF

Senator Daniel Patrick Moynihan

New York

FOR IMMEDIATE RELEASE
THURSDAY, JUNE 10, 1982

Contact: Mike McCurry
Vicki Bear
202/224-4451

STATEMENT BY SENATOR DANIEL P. MOYNIHAN (D-N.Y.)

ON U.S. COMPLIANCE WITH THE 1978 WATER QUALITY AGREEMENT WITH CANADA

HEARING BEFORE THE SUBCOMMITTEE ON

NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT

HOUSE SCIENCE AND TECHNOLOGY COMMITTEE

JUNE 10, 1982

Mr. Chairman, I shall keep my remarks to the Subcommittee brief. I only wish to make a very simple point: the United States is systematically undermining the 1978 Water Quality Agreement with Canada. All of the available evidence points to this conclusion.

While I understand the subject of this morning's hearing is the broader question of water quality research required to fully implement the Clean Water Act, I believe that our nation's compliance with the 1978 Water Quality Agreement with the Government of Canada is a highly visible example of the contradictions which plague this Administration's policy on environmental research and environmental protection.

To put this matter in some perspective, I must say we are talking about very small sums of money, sums that do not even make their way into budget resolutions. The EPA budget for Great Lakes water quality research dropped from $3.3 million in 1981 to zero in the proposed 1983 budget. In 1981 EPA obligated $7.6 million for abatement of pollution in the Great Lakes. In the 1983 budget, only $3.8 million was requested. Thus, to cut those small sums to even smaller sums--without scientific justification and without due consideration of the domestic and foreign policy implications--is all the more puzzling.

The 1978 Water Quality Agreement is quite clear on this point of funding to meet the Agreement's objectives. Article XI, paragraph 2(a) states that the "Parties commit themselves to seek...the appropriation of the funds required to implement this Agreement, including the funds needed to develop and implement the program and other measures...."

Is the budget an accurate representation of the effort and results of the United States Government in cleaning up the Great Lakes? In the case of water quality research, it is an excellent indicator. For in the same breath the Administration tells us less research is necessary these days, they also tell us important deadlines in the Clean Water Act must be stretched out by three more years, including the deadline by which rules governing industry compliance with the "best available technology" requirements of the Act must be put into place. If we know so much already, then why the delay?

As bewildered as many Americans may be with the Byzantine twists of the Congressional budget process, the Canadians I must say reacted to the 1982 budget with a great degree of coherence and thoughtfulness. For example, the Canadians inquired of our State Department whether the United States had considered the effect on our treaty obligations of the proposed budget cuts in water quality research? Apparently, the United States had not thought about the matter too much for it took us over a year to reply to the Canadian's first diplomatic note of April 1981.

While still awaiting a reply to the first note, the Canadians sent a second note asking about the fate of the first but also raising fresh questions about the 1983 budget. The trends in the new budget were even more ominous than in the previous year:

* EPA's Great Lakes National Program Office in Chicago has had its budget cut from $11.1 million in FY1981 to $3.8 million as proposed in the President's FY1983 budget.

* EPA's Large Lakes Research Station in Grosse Ile, Michigan was scheduled to close in FY1981, kept functioning in FY1982 with $2.5 million, a reduction of $4.0 million from the 1981 levels, and totally eliminated from the President's 1983 budget.

* NOAA's Great Lakes Environmental Research Laboratory may not be funded in FY1983. In FY1981 the Lab received $3.2 million and in FY1982 $3.3 million.

The Canadians, I believe, are feeling somewhat betrayed by the Americans. The last American president to visit Canada prior to President Reagan's March 1981 visit was Richard Nixon. The occasion was the signing of the 1972 Water Quality Agreement. When President Reagan met with Prime Minister Trudeau, he gave unequivocal support to the 1978 Agreement.

I know how the Canadians feel about this issue. Last May I was invited to speak at a conference on acid rain at the State University of New York at Buffalo. When I arrived at the conference, the participants including a number of high ranking environmental officials of Canada were in an uproar. It seemed that an associate director of the Office of Management and Budget, scheduled to speak on behalf of the Administration, cancelled at the last minute. As the next American official to appear, I was put in the awkward position of explaining the United States position. On a Saturday morning in Buffalo there was not much I could do but call the then Deputy Secretary of State William Clark to ask for a statement of Administration policy. A hurried telegram from Mr. Clark did little more than smooth over an unpleasant breach of diplomatic etiquette.

Taken as a whole I regard our government's performance on the Water Quality Agreements to be miserable. Canada and the United States have common needs. We should have common goals. Support for aggressive and stringent controls on toxic pollution is widespread in this nation. If the Administration fails to heed the public demand for concerted and swift action to control the contamination of our waters by toxic pollutants, then one would hope at the very least that the power of an international treaty would change their minds. But it will probably take strong actions by Congress to bring them to this conclusion. You are to be commended, Mr. Chairman, for the leadership taken by this Subcommittee to restore funding for Great Lakes water quality research. I intend to support similar funding levels in the Committee on Environment and Public Works of the Senate of which I am a member.

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COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
(202) 225-6371

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July 9, 1982

Honorable Elliott H. Levitas, Chairman
Subcommittee on Investigations and Oversight
Committee on Public Works and Transportation
U. S. House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

As you are aware the Clean Water Act is scheduled for reauthorization this year. In order to enhance Congress' ability to perform this task the Subcommittee on Natural Resources, Agriculture Research and Environment held hearings on June 8 and June 10, 1982 to determine the research needs of the Clean Water Act. The Subcommittee was especially interested in determining the extent to which a scientific basis exists that supports or rejects the Administration's proposed amendments to the Act. Testimony was received from scientific, environmental, municipal, industrial, and state groups, in addition to witnesses from the Administration.

Dr. John Hernandez, Deputy Administrator, U.S. Environmental Protection Agency (EPA), discussed the Administration's proposed amendments to the Clean Water Act, stating that "Most of them have been recommended by a Subcommittee [Investigations and Oversight] of the House of Representatives in a December, 1980 report [Committee Print 96-71, Implementation of the Federal Water Pollution Control Act], a report that is signed by most of the Members of the Public Works Committee."

Since almost 2 years have elapsed since the publication of your Subcommittee's report, we would welcome your opinion on the extent to which those recommendations made in the last Congress are still valid today. My colleagues and I would also appreciate your views of how well EPA's proposed amendments reflect your Subcommittee's recommendations, especially on the control and abatement of toxic chemical discharges into the Nation's waters. We have enclosed for your information copies of EPA's written and oral testimony and the Administration's proposed amendments to the Clean Water Act.

We look forward to your reply to these questions, anticipating your response to be both informative and valuable to our Members. If you have any questions, please contact me or have your staff contact Mr. Brian Burby of the Subcommittee staff at 225-8127.

With every warm best wish,

Sincerely,

JAMES H. SCHEUER
Chairman
Subcommittee on Natural Resources,
Agriculture Research and Environment

JHS/Bgb

Enclosure

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LARRY REIDA, MINORITY COUNSEL

Committee on Public Works and Transportation
U.S. House of Representatives
Room 2165, Rayburn House Office Building
Washington, D.C. 20515
TELEPHONE: AREA CODE 202, 225-4472

B-376 Rayburn Building
Washington, D.C. 20515
August 4, 1982

Honorable James H. Scheuer
Chairman
Subcommittee on Natural Resources,
Agricultural Research and Environment
Committee on Science and Technology
2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Chairman:

I am writing in response to your July 9, 1982, letter to me concerning the Subcommittee's 1980 review and recommendations on the Clean Water Act's toxic chemical discharge control program, and the extent to which the Administration's recent proposals (H.R. 6670) to amend that law reflect the Subcommittee's views. I have discussed this matter with my Committee colleague, Norman Y. Mineta, who, as you know, was Chairman of this Subcommittee at the time this report was written. He and I concur on the following points.

In the 1980 report, "Implementation of the Federal Water Pollution Control Act," (Committee Print 96-71), the Subcommittee concluded that the control and abatement of toxic chemical discharges should remain as the primary focus of the clean water program. The Subcommittee also felt that technology-based controls, as opposed to water quality-based controls, would "continue to be the most reliable means for establishing toxic control requirements for the near and intermediate future." Finally, the Subcommittee concluded that if the Law's toxic control programs were to be effective, more reasonable time frames would be necessary, time frames that would take into account the massive slippages and delays by the EPA in the past, without removing the necessary incentives to assure timely cleanup by polluters.

From this perspective, I believe the thrust of the Administration's proposal, so far as toxic pollution control is concerned, does parallel that suggested by the Subcommittee. There are, however, certain differences, some of them significant, between three of the Subcommittee's recommendations and the language contained in the Administration's proposal to address them. The first of these involves the deadline by which industries must cleanup their toxic chemical discharges, section 2 of the Administration's bill.

The Administration has recommended that the date for industry compliance with both the law's "Best Conventional Treatment" (BCT) requirements for minimum control of commonly occurring pollutants, and "Best Available Treatment" (BAT) for toxic pollutants, be extended by four years, from July 1, 1984 to July 1, 1988.

The Subcommittee recommended that the deadline for the BAT toxics requirements (BCT was not addressed by the Subcommittee), be extended up to three years, but that no extension be authorized beyond July 1, 1987. The Subcommittee's recommendation was deemed necessary to compensate for the repeated failures of the EPA to meet both federal court and statutory deadlines for developing and issuing the required industrial clean up standards, or "effluent limitations", as they are commonly called. The need for this adjustment still exists.

It is my understanding that EPA now estimates that it will finally be able to complete the task of issuing BAT level toxic pollutant effluent limitations for the approximately 23 industrial categories involved, by early 1984, a delay of slightly more than four years from the original court ordered deadline. Given the three years necessary, on average, to design, install, and start-up the necessary BAT control technologies, this, then, would mean that industries in the final categories to be addressed under the agency's staggered rulemaking schedule would not be able to be in full compliance until early to mid 1987. This also means that industries for which effluent limitations are finalized earlier (I believe that final BAT-toxics limitations have been issued for three industrial categories) can be in compliance earlier than 1987, assuming the same three year compliance time.

For those industries for which final effluent limitations have already been published, the three-year compliance period would require only a one year extension of the deadline. For those industries whose regulations are finalized between now and early 1984, the three-year compliance time would require deadline extensions of varying length. The last industries being addressed would need the full three-year extension. It is with respect to the first two groups, industries for which limitations have already been, or will be published before 1984, that the language of the Administration's proposal falls short of that sought by the Subcommittee. There appears to be little justification for allowing all industries the same extension, since the delays are not identical in all cases. Further, the need for an across-the-board, four year extension also appears to be unjustified, largely for the same reasons. Therefore, changes in the legislation to extend BAT deadlines only to the extent necessary in each industrial category, would appear to be more appropriate, and more in keeping with our 1980 recommendation.

The second issue of concern, addressed in section 7 of the Administration's bill, involves the law's requirements for controlling toxics from indirect dischargers, that is, industries that discharge their wastewater into municipal sewers, rather than directly into rivers and lakes, etc. These indirect dischargers are required to "pretreat" their wastes to prevent toxic pollutants from interfering with the performance of the municipal treatment plant, or, from passing through the plant untreated.

The "pretreatment program," as it is commonly called, is a critical component of the Act's overall strategy for controlling toxic chemical discharges, and was a major focus of the Subcommittee's review in 1980.

There was very little, if any, debate then, nor is there now, as to the need for a sound and workable pretreatment program. It is essential. Yet, EPA's performance in implementing this provision of the law has been dismal. As was noted in the December 1980 report:

> After eight years of trying, EPA has been almost totally unsuccessful in implementing this requirement of the law. The job has proven to be as difficult as the setting of toxic controls for direct dischargers.***When the Subcommittee convened its June 1980 oversight hearings, it was readily apparent that the Nation was still without the mandated national industrial pretreatment program called for in 1972...Testimony on the problems created for local officials by EPA's general pretreatment regulations

> and the standards proposed for some industrial categories left the Subcommittee with considerable doubt about the workability of the proposed approach for controlling indirect toxic dischargers.

The Subcommittee's 1980 investigation identified two basic stumbling blocks to the pretreatment program's effective implementation: the law's requirement that EPA develop uniform, categorical pretreatment standards for the approximately 23 industrial categories, and the law's pretreatment "removal credit" provision.

The problems encountered in issuing the pretreatment standards were, and continue to be, the same as those the EPA has experienced in attempting to issue the BAT toxic discharge effluent limitations: the task has proven to be more costly, time consuming, and scientifically complex than originally contemplated. The problems with the removal credit provision are both technical and administrative in nature, and equally troublesome.

The removal credit provision is a mechanism placed in the law in 1977 to avoid requiring industries to build treatment systems that would duplicate treatment provided by the municipal works, resulting in excessive or redundant treatment with no additional water quality benefits. Local officials could, pursuant to EPA guidance and approval, reduce the uniform categorical pretreatment standards by giving industry "credit" for the amount of a restricted toxic pollutant that was already being removed by the municipal treatment works. Unfortunately, the combined effects of overly complex EPA regulations, and difficulties in measuring and allocating the credits themselves, has made the provision, from a practical standpoint, virtually impossible to implement.

In view of these findings, the Subcommittee sought a more direct approach for moving this program off-center, and recommended that the law be amended to allow pretreatment requirements to be established by local treatment authorities on the basis of their National Pollutant Discharge Elimination System (NPDES) permit. The Subcommittee also recommended that the trouble-plagued effort to establish national uniform categorical pretreatment standards be abandoned, substituting in its place technology based effluent limitations for toxic chemicals; the latter to be included in municipal NPDES discharge permits to ensure cleanup is achieved.

While some remedial changes to the pretreatment regulations by the EPA are being contemplated, and two or three of the 23 industrial uniform categorical pretreatment standards have been finalized, the program is still in need of simplification, particularly changes that would expedite the putting-in-place of a national pretreatment program. In this regard, I believe the Subcommittee's 1980 recommendation, is still sound. It would simplify the pretreatment program's requirements while retaining the law's fundamental technology-based approach to establishing clean-up requirements. It would also minimize, or eliminate any justification for delay by municipalities that have refrained from upgrading their pretreatment standards until EPA publishes its national uniform, categorical limitations.

Here again, the Administration's recommendation to change the pretreatment program's requirements generally heads in the direction suggested by the Subcommittee. There are, though, certain aspects of it that differ significantly. First, their proposal, stripped of its extensive verbiage, would authorize the abandonment of virtually all of the categorical industrial pretreatment standards without requiring the substitution of technology-based toxic effluent limitations in municipal discharge permits. Second, their proposal would retain the credit provision approach, and all the administrative problems that accompany it.

Third, the Administration's pretreatment provision differs significantly from the Subcommittee's recommendation in that it proposes to use water quality standards as a basis for waiving the pretreatment program's toxic cleanup requirements. This approach would seriously undermine the very integrity of the industrial pretreatment program. This is due to significant deficiencies inherent in setting and using water quality standards for controlling toxic chemicals. The Subcommittee, in its 1980 report, concluded that the use of water quality standards should continue to be relegated to a secondary role in the program. Some excerpts from the report are illustrative as to why:

> In the simpler program prior to 1972, treatment requirements were based primarily on a determination of what was necessary to meet a desired set of conditions in a water body. State water pollution control agencies assigned uses to each stream, such as fishing, swimming, water supply, and industrial use. Subject to acceptance by

the public, the most sensitive use for each stream was then defined by a set of "criteria" which became the operative "water quality standards."

Water quality standards proved to be deficient in too many respects to be considered a reliable basis for determining treatment requirements. Criteria for many parameters, such as heavy metals, oil and grease, and nutrients, were often vague, in some instances consisting of little more than narrative statements limiting their presence "in any harmful amount." Even where there were specific numbers, such as for pH, suspended solids or coliform bacteria, they were often stated in widely varying ranges depending on the water body in question and a particular State's law and policies.

The scientific tools, particularly the mathematical models for translating water quality standards into specific pollution control limitations, also were a stumbling block. Focusing on only a few parameters and relying heavily on numerous assumptions (often because of a lack of data), these models tended to compound the weaknesses and ambiguities of the water quality standards themselves.

* * *

Data available on chemical toxicity in water, particularly long-term, low-level exposures, is sparse. While very significant gains have been achieved in the past few years in the development of short-cut analytical techniques for assessing aquatic toxicity, the regulatory focus on reducing the amounts of specific substances has diverted attention from efforts to identify the significance of such pollutants. The overriding objective has been to reduce

> the presence of questionable substances, leaving the elusive matter of definitive justification to the future.
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> * * *
>
> Another weakness in water quality-based approaches for controlling toxic pollutants lies in the area of analytical technology. The detection and quantification of small concentrations of compounds that are of concern require the use of highly sophisticated, costly and complex analytical methods and tools, and usually the services of highly trained research-level chemists. Further, the results of these testing techniques, particularly those below the ten "parts per billion" level, are not considered reliable, varying up to several hundred percent.

The fact that the Administration is seeking to use water quality standards as a key determinant in the pretreatment program is also disturbing for two additional reasons: First, the Administration, or more specifically the EPA, is quite aware of the limitations of water quality standards, particularly with respect to their utility for controlling toxic chemicals. The need to improve water quality standards so they may be of greater future use is high among the EPA's research and development priorities, and those of the new EPA Assistant Administrator for Water Programs as well.

Second, the use of water quality standards as the basis for waiving toxic chemical clean-up requirements also signals a major policy change within the Agency. In testimony to the Subcommittee in 1980, the EPA advised that insofar as their being used to determine toxic chemical clean-up requirements, water quality standards were best relegated to a secondary position. The Subcommittee is aware of no new evidence that would justify otherwise at this time. Yet, using the standards as a basis for waiving toxic chemical pretreatment requirements as the Administration's bill suggests, clearly places them in a primary role, and hence, is contrary to prior agency policy.

In summary, the Administration's proposal to modify the pretreatment program, while heading in the right direction, goes far beyond that suggested by the Subcommittee in 1980. Further, it does little to eliminate many of the complex administrative problems that have plagued this particular program, and perhaps, may even add to them.

The third issue addressed by both the Subcommittee in its 1980 report, and contained in the Administration's proposal, is the need to lengthen the period during which an EPA (or state) issued National Pollutant Discharge Elimination System (NPDES) permit remains valid.

As you know, the law presently requires that anyone who discharges an effluent into a body of water must have an NPDES discharge permit that sets forth the effluent limits that are to be met, and, for those who must install clean-up technologies, compliance schedules for doing so. Further, the law provides that these permits have a life-span of up to five years.

Reviews of the NPDES permit program by the Subcommittee over the past few years, as well as in 1980, indicate that the five-year permit validity period is inadequate. Federal and state personnel and other resource limitations have led to delays in the processing of thousands of permit applications. Frequently, dischargers are issued permits that are valid for only a few years, or even months. In one instance, a permit was valid for only a few weeks due to the length of time involved before issuance.

EPA's continued inability to issue the BAT-toxics effluent limitations on schedule has also added to the problem. Lacking these limitations, but facing the need to issue permits, EPA has fallen back on a policy of issuing open-ended permits, that is, reserving the right to come back after the permit is issued, even if less than five years has elapsed, and alter the terms of the permit. While such an approach is necessary if toxics are to be controlled, industrial dischargers are often unable to plan and take decisive steps, such as ordering and installing necessary clean-up equipment, because they are uncertain as to just what they may be called on to do in the immediate future. Lengthening a permit's validity period would eliminate much of this problem.

Another, and equally serious problem that would be addressed by the lengthening of the permit's effective life span is the inability of the EPA and most states to review and issue, or re-issue NPDES permits efficiently and expeditiously. Our 1980 review found that the national permit program was on the verge of collapse. As many as 60 thousand permits had either never been issued, or had expired and were in need of review. Further, another 9 thousand permits were in need of some sort of adjustment or modification. The staffing and budget cuts that have been experienced at both federal and state levels over the past two years does little to suggest that this problem is being alleviated.

The Subcommittee, in recognition of the real-world constraints of budget limitations and the ability of the EPA to finish issuing the mandated BAT-toxic effluent limitations, concluded that a permit validity period of from eight to ten years would be more realistic and reasonable, and would provide some of the stability and certainty necessary for industries to act on clean-up requirements. When viewed in conjunction with the Subcommittee's first recommendation in the 1980 report, that the "Clean Water Act's current emphasis on controlling and abating the discharge of toxic chemicals....be continued," changes in the law that would allow *NPDES permits containing BAT-toxic limitations* to be valid for eight or ten years would be in keeping with the Subcommittee's overall set of recommendations. Consequently, I believe that the thrust of this Subcommittee recommendation, and that made by the Administration in Section 12 of their legislative proposal, to lengthen the validity of the NPDES permit, is still valid, and constitutes a necessary change.

The Subcommittee's 1980 report also addressed one other issue not included in the Administration's legislative proposal package: case-by-case modifications of BAT-toxic discharge permit requirements. Specifically, the Subcommittee recommended that industrial dischargers be allowed to apply for such modifications "in those instances where a discharger can demonstrate on the basis of *biological testing* that his *effluent* will not pose a threat of *acute or chronic* toxicity to the aquatic environment." (Emphasis added.)

There were several factors contributing to this recommendation. First, the Subcommittee found that the so-called "Best Practicable Treatment" (BPT) technologies called for in the first stage of the law's industrial pollution abatement strategy actually removed greater quantities of the EPA's priority pollutants than expected. Second, the Subcommittee also found that many of the 129 toxic "priority pollutants" on which the industrial regulatory program is now focused are less evident in both amounts and concentrations than previously believed.

The third, and perhaps most important factor, however, was the realization that the current approach of defining Best Available Treatment in terms of the chemical quantities reduced fails to take into account the amount of "toxicity" reduced, which after all, is the purpose of the BAT effort. Without this type of information, no one can determine if the yet-to-be issued BAT limitations provide adequate, or inadequate levels of toxic chemical control.

Testimony to the Subcommittee in 1980 also established that considerable progress had been made during the past few years in developing bioassay techniques for evaluating the chronic, as well as acute toxicity of treated effluents. These techniques can, and have been used to determine the toxicity reducing capabilities of various clean-up technologies. Further, because they assess the toxicity of a total effluent, and not just one individual chemical, they have the added advantage of overcoming the analytical problems that often occur when more than one chemical is present in an effluent, as is usually the case. In short, this approach offers a means to retain the technology-based approach embodied in the law, while re-targeting the thrust of that approach directly on the toxicity of the chemicals in an effluent, rather than the quantity.

In addition to the foregoing, the Subcommittee's recommendation was also predicated on two additional factors, both stemming from testimony by EPA officials to the Subcommittee: (1) that the BAT standards being set by EPA were going to be considerably more stringent than the BPT standards now in existence; and (2) that the BAT standards would be issued without further delay, the majority of them being available by early 1982, or shortly thereafter. Neither of these two conditions have been realized.

Information provided to the Subcommittee indicates that many of the BAT limitations will not be finalized until early 1984, at best. Further, many of the BAT effluent limitations are expected to be either close to, or identical to the earlier less stringent BPT levels. To the extent that this latter situation does occur, the need for a BAT-toxics modification provision is obviated.

As noted above, the Administration did not address this Subcommittee recommendation in its legislative proposal. However, in the letter of transmittal, EPA Administrator Anne M. Gorsuch did advise that the "BAT waiver" provision, as she refers to it, was not included, "not because our concerns have changed, but because we feel that the development of an appropriate legislative mechanism is premature." Given the additional delays that have occurred in developing the BAT limitations, and the prospect that the final BAT requirements may differ little from the earlier, and less stringent BPT requirements, I must agree that the most prudent course at this time is to "wait and see."

In closing, I want to thank you for your interest in the Subcommittee's effort to monitor the national clean water program. Our ability to address such important questions as controlling toxic chemical pollution is going to be heavily dependent on the priority and degree of support that the federal government gives to the research and development of clean-up technologies, and the analytical tools to evaluate their effectiveness. In this regard, your task is a most important and valuable one, and I hope that the foregoing information is of assistance to you. I have enclosed a copy of the 1980 Subcommittee report for your use and information. Should you have other questions on this matter, please let me know.

With best wishes, I am,

Very truly yours,

Elliott H. Levitas
Chairman
Subcommittee on
Investigations and Oversight

EHL/tjm
cc: Honorable Norman Y. Mineta

EPA's BLUEPRINT FOR REVERSING A DECADE OF PROGRESS TOWARD CLEAN WATER

Statement by:

JAMES TAYLOR BANKS
Senior Attorney

NATURAL RESOURCES DEFENSE COUNCIL, INC.

Mr. Chairman, I appear before you today with what we consider startling, disturbing news about the future of toxic water pollution control in this country. Through six years as an NRDC attorney, and before that as a civil engineer, I have watched virtually every detail of this program as it evolved under Republican and Democratic administrations. From that perspective, I tell you today that its darkest days lie just ahead.

Two very troubling policies are unfolding at EPA. I believe they will halt, and probably reverse the progress that Congress and this Agency have achieved over the last decade.

First, EPA apparently has decided to systematically eliminate the Clean Water Act's requirements that industries curtail toxic water pollution discharges by July 1, 1984. EPA has made up its mind to cause long, unnecessary delays in the entire toxics control effort.

Second, EPA has decided unilaterally to reverse Congress's considered judgment on the best means to control point-source discharges. By its own admission, EPA is embarking on an approach that will not work now, and cannot be made to work effectively until 1990 or beyond.

These conclusions are apparent from the Agency's own budget documents. Last Thursday, some of those documents were discussed in hearings before the Senate Committee on Environment and Public Works. Others are contained in an April 1981, printed report by the House Committee on Appropriations. Still others I have with me today.

As you know, EPA budget documents have been the subject of some dispute lately. Last week the Administrator belittled the meaning and importance of EPA's FY 1983 budget submission because the overall budget process is not complete. That is an absurd and evasive characterization of EPA's official budget request. In a sworn affidavit before a United States District Court,[1/] Ms. Gorsuch has stated that in preparing the budget submission she personally reviewed staff drafts to ensure that they are consistent with her regulatory prirorities and her budget targets:

> It is my responsibility to assure that the draft budgets prepared by the various EPA Offices are nonduplicative, consistent with my regulatory priorities, and within my budgetary targets. Therefore, I review these drafts and, if necessary, request that the draft budgets be modified. EPA staff must then rewrite the draft budgets and the accompanying narrative discussions.

[1/] Ms. Gorsuch's affidavit, dated September 24, 1981, is attached to this written statement (see p. 4). The affidavit was filed in the case to support EPA's position that NRDC, the Congress, and the public should not be permitted to examine EPA's budget decisions.

> After this process is completed, I am required to submit the draft EPA budget to OMB ... (For example, on September 15, 1981, I submitted EPA's FY 1983 budget request to OMB.

There seems to be no real question that these document do reflect the Administrator's intentions and policy decisions, whether or not she is willng to admit it.

The ongoing negotiations with OMB do not change that fact, but we believe give even greater cause for alarm. In public discussions on the budget, the Administrator has shown herself to be a shrewd lawyer. Any good lawyer knows that you don't open a negotiation with your bottom line. OMB may impose even further cuts in this disastrous budget, as it invariably has done in the past.

But let's put the numbers aside for a moment. You do not need an intricate analysis of budget numbers to realize that EPA is bent on dismantling the toxic water pollution program. The "narrative discussions" in EPA's secret budget submissions -- personally reviewed by the Administrator -- reveal these policies on their face. I believe there is an important link between EPA's resources and its performance. But one does not have to wage a war of numbers with the Administrator to see the stark evidence of major, unilateral policy shifts in EPA's water pollution program.

I. How Did We Get To This Point?

EPA's current toxics control effort is the product of scientific and policy debate lasting nearly a decade.[2] It began with passage of the Federal Water Pollution Control Act Amendments of 1972. In crafting the FWPCA, Congress considered old options and new ones, and ultimately laid the groundwork for a comprehensive, coordinated attack on the degradation of our nation's waters.

Most important of all, Congress saw clearly that the prior philosophy of discharge controls in this country had not worked, and could not be relied upon as the first line of defense against water pollution. That philosophy had been built on a serious error in judgment: that the states could determine how clean a given stream should be, and then from that determination develop discharge controls for each source of pollution. Congress was convinced that the old approach had failed miserably because:

- the scientific understanding was not there to determine how "clean" a given stream should be -- particularly for toxic pollutants;
- there were no reliable methods for translating in-stream standards into appropriate discharge limits; and
- as long as controls were left primarily to the states, industrial sources had an opportunity to

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[2] See Hall, "The Evolution and Implementation of EPA's Regulatory Program to Control The Discharge of Toxic Pollutants To the Nation's Waters," 10 Nat. Resources Lawyer 507 (1977); Hall, "The Clean Water Act of 1977," 11 Nat. Resources Lawyer 343 (1978).

shop for lenient states, thus creating pressure on all states to relax their standards.

Second, and as a direct consequence of this realization, Congress decided that uniform, technology-based regulations should be the primary industrial control vehicle. The technology-based rules (BPT, BAT, etc.) merely would require "practicable" or "economically achievable" controls -- whether or not one could determine that they were adequate to protect public health. Congress relegated state water quality standards to a backup role. Where the necessary scientific knowledge is available, state standards would require additional controls beyond the baseline afforded by uniform limitations.

Third, the 1972 FWPCA placed special emphasis on toxic chemicals. A separate control vehicle was prescribed -- toxic effluent standards -- that would set limitations for each pollutant, and be designed to protect public health with an ample margin of safety. EPA was to develop these standards within 15 months -- by the spring of 1974.

That was the structure and the challenge in 1972. When EPA failed to meet the challenge, it was sued repeatedly from 1973 through 1975. EPA devised a new, comprehensive toxics control program, and in a 1976 Consent Decree, bound itself to carry out that program by the end of 1979 (the so-called "Flannery Decree").

The Consent Decree laid out a different and far more workable structure for toxic industrial controls:

1. EPA would use technology-based limitations instead of health-based effluent standards to regulate toxic industrial discharges. By December 1979, EPA would issue BAT limitations, new source standards and pretreatment standards for each major industrial sector, and would cover a list of 65 toxic chemicals in those rules.

2. In order to assess the effectiveness of the new rules, EPA would publish criteria for each of the 65 chemicals. Each criterion would establish, based on the latest scientific knowledge, the maximum recommended concentration of the pollutant needed to protect public health and aquatic life.

3. By comparing those criteria to the probable in-stream conditions produced after implementing BAT controls, EPA then would decide which lakes and rivers (and which pollutants) need even more stringent toxics controls, and would move promptly to develop them.

4. EPA would review all of its sampling data to determine whether other toxic chemicals -- not on the list of 65 -- should be controlled before discharge into sewage treatment plants. If any were found, EPA would develop the necessary pretreatment standards.

5. Finally, EPA would implement BAT limitations as expeditiously as possible through the Act's national permit system.

In 1978, EPA asked for relief from some of these requirements. The job had proved to be more difficult than anticipated, EPA said, and resources were limited. NRDC agreed to modify the Consent Decree, giving EPA more time and flexibility to implement this program. We allowed until 1980-81 to complete the BAT rulemakings, and extended other deadlines as well.

Meanwhile, Congress considered and enacted comprehensive amendments to the FWPCA, producing the Clean Water Act of 1977. In so doing, Congress strongly endorsed the Consent Decree, particularly its fundamental shift to a technology-based system for controlling industrial toxics. Portions of the decree actually were placed in the law itself. A new variance was added to the Act, permitting industries to relax some BAT requirements where they could show no harm to water quality. But Congress expressly rejected the notion of allowing these variances from BAT limits on toxics -- because, Congress found, the science was not there to make such decisions.

The 1977 amendments prompted a score of industry parties in the case to ask Judge Flannery for an order vacating the Consent Decree. Since Congress had acted, they claimed, there was no need to continue a court order binding EPA's discretion on how to carry out the law. The court refused, finding specifically that Congress expected the decree to remain in effect and furnish the details of EPA's program that had not been codified.

On appeal, the U.S. Circuit Court agreed. But the Court sent the case back for Judge Flannery to decide, as a matter of law, whether a consent decree can bind the Agency's discretion beyond that specifically required in the statute. Industry parties said it could not. The Justice Department, on behalf of EPA and the executive agencies generally, said there was no rule of law prohibiting such decrees. We believe there is no doubt about the legitimacy of this decree.

Early this year, however, the industry parties began lobbying the new EPA officials and the White House to press for relief from the court order. In February, a "Briefing Paper" (attached) was prepared for EPA, urging the Agency to join industry efforts to get rid of the program. On April 8, 1981, the American Iron and Steel Institute wrote to the Acting Administrator requesting his support for vacating the decree (letter and background paper attached). On May 1, 1981, ten chemical companies joined in a letter to numerous government officials urging the same result (copy attached). And on May 1, 1981, the Chemical Manufacturers Association recommended that Vice President Bush pursue the matter.

In June, EPA Administrator Anne Gorsuch was presented with the various options: (A) seek to vacate the decree; (B) ask the court for modifications; or (C) continue EPA's program under the current agreement. Her staff's briefing memorandum (attached) thoroughly laid out industry's requests and attached their letters. It noted that EPA would be hard pressed to justify industry's preferred option (Option A) of vacating the decree, but that industry would be "pleased with the choice of Option B" -- a request to modify the court's order. With Option B, the staff said, "we are more likely to prevail in establishing an extended 'stretched-out' schedule justified by resource constraints than in avoiding any schedule at all."[3/]

Sure enough, that is what the Administrator chose to do. On August 3, 1981, EPA asked the court for extensive changes to the program. The schedule for issuing BAT and other technology based rules should be extended through the end of 1983, EPA said, because "unforseeable circumstances" had intervened. Resources were scarce, and the burdens of other programs (such as RCRA) had consumed some of EPA's water program funds. The situation is so desparate, EPA claims, that a good deal of the decree should be eliminated. EPA has asked to be relieved of its duties to:

- complete the development of the water quality criteria for toxics;
- go forward with its program to identify and clean up toxic hot spots;
- issue standards to control pervasive toxic chemicals; and

[3/] The memorandum notes that "obviously, the choice of either Option A or B would not please the environmentlists" -- an astute observation.

- determine whether other toxic chemicals should be regulated.

In addition, EPA would have the court simply drop its obligations to address 12 industries or portions of industries out of the 34 categories covered by the decree.

Table 1 below shows the delays EPA has requested in its motion to the court. EPA would take an additional 3-30 months to propose these regulations, and 13-44 months longer to issue them in final form. Moreover, EPA's promulgation dates would precede industry's July 1, 1984 compliance deadline by less than two years in numerous cases.

TABLE 1

	Proposal			Promulgation			
Industry	Consent Decree 3/9/79	EPA Motion 8/3/81	Delay (months)	Consent Decree 3/9/79	EPA Motion 8/3/81	Delay (months)	Time Remainir for Permittir Planning, Cor ruction (mont
Adhesives	2-80	dropped	-	8-80	dropped	-	
Leather	1-79	7/2/79	6	8-79	3-82	31	27
Soap & Detergent	7-80	dropped	-	1-81	dropped	-	-
Aluminum	3-80	2-82	23	10-80	4-83	30	14
Battery Mfgr.	3-80	6-82	27	10-80	7-83	33	11
Coil Coating	8-79	1/11/81	16	3-80	10-82	31	20
Copper Forming	4-80	9-82	29	11-80	9-83	34	9
Metal Finishing	3-80	12-81	21	10-80	12-82	25	18
Foundries	10-79	7-82	21	5-80	10-83	41	8
Iron & Steel	11-79	1/7/81	13	5-80	1-82	20	29
Nonferrous Metals	8-79	8-82	24	3-80	11-83	44	7
Photog. Supplies	2-80	dropped	-	8-80	dropped	-	-
Plastics Processing	10--80	dropped	-	5-81	dropped	-	-
Porcelain Enameling	10-79	1/27/81	15	5-80	10-82	29	20
Gum & Wood	8-79	dropped	-	3-80	dropped	-	-
Paint	9-79	1/3/80	3	4-80	2-82	22	28
Ink	9-79	1/3/80	3	4-80	2-82	22	28
Print & Publishing	11-79	dropped	-	6-80	dropped	-	-
Pulp & Paper	2-80	1/6/81	10	8-80	8-82	24	22
Textiles	5-79	10/29/79	5	12-79	3-82	28	27
Timber	5-79	10/31/79	5	12-79	1/26/81	13	41
Coal Mining	12-79	1/13/81	13	6-80	7-82	25	23
Ore Mining	11-79	10-81	23	7-80	7-82	24	23
Petrol. Refining	3-79	12/21/79	9	10-79	5-82	31	25
Steam Elect.	5-79	10/14/80	17	12-79	6-82	30	24
Org. Chemicals	1-80	7-82	30	8-80	5-83	33	13
Pesticides	3-80	1-82	22	10-80	11-82	25	19
Pharmaceuticals	12-79	6-82	30	7-80	4-83	33	14
Rubber	6-79	dropped	-	1-80	dropped	-	-
Auto & Other Laundries	12-79	dropped	-	7-80	dropped	-	-
Elect. & Electron. Comp.	3-80	5-82	26	10-80	5-83	31	13
Explosives	12-79	dropped	-	7-80	dropped	-	-
Inorg. Chem.	9-79	7/24/80	10	4-80	2-82	22	28

Note: The underlined dates are actual proposal and promulgation dates.

In response to EPA's motion, NRDC has asked the Agency for documentation of its claim that unforseen circumstances warrant these changes. We are particularly interested in EPA's budget submissions because they will reveal whether EPA was confronted with resource constraints, or created those "restraints" after having made policy decisions to modify and stretch out this program. So far, EPA has refused to disclose budget materials for Fiscal Year 1983, and has agreed to our inspection of documents for FY 1979-82 only pursuant to a secrecy order. Under the proposed order, we would be bound not to disclose any information; would file all papers under seal; would argue the case in private; and would destroy all of our notes after the litigation. NRDC has not agreed to proceed in secret.

II. Where Does The Toxics Program Stand?

EPA's toxic water pollution program is at a standstill. The Agency has not promulgated a dozen regulations that were proposed between July 1979 and January 1981. Eleven others have not even been proposed. The program to identify and clean up toxic "hot spots" is in complete disarray. And EPA has suspended its pretreatment program for an extended period, even though final regulations were ready in 1978. Each of these efforts is critical to the success of the comprehensive national strategy to control industrial toxics.

A. The Technology-Based Regulation Freeze.

As Table 1 indicates, about one-half of the technology based regulations have been proposed, but their deadlines were missed by 3-17 months. Still, these rules were proposed as far back as July 1979 (Leather Tanning), and the most recent proposals were made in January of this year (Coil Coating, Iron and Steel, Porcelain Enameling, Pulp and Paper and Coal Mining), over nine months ago. Except for regulations governing discharges from Timber Products dischargers, none has been promulgated.

EPA currently predicts delays in proposing regulations of up to 30 months, and promulgation delays of 13-44 months. On the average, this entire program has slipped nearly three years from the targets EPA set when it designed the strategy.

The consequences of these delays are enormous. We are talking about industrial discharges containing highly toxic chemicals. Some are known or suspected carcinogens (arsenic, cadmium, chromium, PCB, phenols). Some may cause birth defects (arsenic, phenols, phthalate esters). Most have the potential to cause acute and chronic toxic effects in aquatic life. And many are known to bioaccumulate in the food chain (silver, mercury, PCB, lead, copper and pesticides).

Current discharge permits (based on BPT) are not designed to address these chemicals. Some facilities may incidentally remove a portion of the toxics from their discharges, but that removal generally is neither documented nor known to be sufficient. For example, a recent EPA survey of 26 major chemical company discharges on the Niagra River showed that existing permits have essentially no limits on organics.

Consequently, the BAT guidelines and permits are crucial for controlling these discharges.

Since there are virtually no final rules, it is impossible at present to say how much pollution control would be accomplished with BAT regulations. The degree of control will be defined by the rules, if and/or when EPA issues them. Some estimates are possible by examining the proposed rules for a few of the industries, but it should be remembered that these are not the most serious polluting industries.

In the Inorganic Chemicals industry, EPA predicts that its proposed BAT rule would bring about the annual removal of nearly 800,000 pounds of chlorine, 4.5 million pounds of toxic metals, 166,000 pounds of fluorides and 260 million pounds of iron. Steam Electric power plants would remove over 17 million pounds of chlorine and 157,000 pounds of toxics such as chromium, zinc and PCB. Petroleum refineries would stop discharging 123,000 pounds of chromium, 86,000 pounds of phenols and, according to EPA, "substantial quantities of other toxic pollutants." The Paint industry alone would remove over 100 metric tons of toxics each year. Iron and Steel Manufacturers would remove 1,900 tons of toxic organic chemicals, 2,500 tons of toxic metals and 130,000 tons of other pollutants. And Leather Tanners would remove 284,000 pounds of chromium, 374,000 pounds of sulfide, and 54 million pounds of conventional pollutants.

These are not insignificant gains, and by definition EPA has proposed to implement them as "economically achievable" pollution cleanup requirements. The rules just mentioned are many months overdue. If those delays translate into delayed compliance, the amounts of pollutants noted above will have been needlessly discharged in violation of the Act's goals and requirements.

B. The "Hot Spots" Hot Potato.

As I mentioned, EPA is required to identify and address toxic "hot spots" of pollution around the country. These are areas so seriously contaminated that public health and aquatic life will not be protected adequately even after BAT limitations are achieved by industrial sources. EPA was to identify these areas by July of this year. By the end of the year, EPA must publish a specific strategy and a schedule for addressing each area through the development and implementation of additional controls.

Moreover, EPA must identify those toxic pollutants for which more stringent controls may be necessary nationwide or on a broad geographical basis. The pollutants must be selected by July 1981, and strategies to control them must be published by December.[4]

On July 27, 1981, EPA released a briefing paper (attached) purporting to comply with the July 1 deadline. It identifies streams in 34 metropolitan areas as "projected to be the most polluted after implementation of technology based controls," and lists 12 pollutants "which may require additional controls on a nationwide or broad geographic basis." Four pollutants were listed under "human health risk," and eight under "aquatic life risk."

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[4] In EPA's recent proposal to "modify" the consent decree, all of the responsibilities described above would be eliminated.

NRDC released this information, and numerous newspaper articles were published around the country in the ensuing weeks. In mid-August, Administrator Gorsuch wrote to all of the mayors belittling and attempting to discredit the study as only a desk-top analysis (sample letter attached). Ms. Gorsuch attacked NRDC for releasing the information, and assured the mayors that EPA only did the study because it was required to do so. Another EPA official, Mr. Tim Stewart said: "the list was based on reports that were the result of guesswork."

NRDC then found out that most of the hot-spot studies were backed, in part, by actual ambient data showing potential toxics problems in many of the cities. In some cases, EPA reports even predicted that drinking water intakes could be in jeopardy. We wrote to the mayors (letter attached) urging them to inquire further about these studies, and on August 31, 1981 filed a formal request with EPA for this data.

EPA's answer to our request was delayed for nearly a month, even though the documents were clearly identified in a Headquarters office. The delay gave EPA enough time to prepare documents and a press release (attached) poking holes in its own work. EPA claims its data are not good enough to confirm that problems exist in some areas, but for other areas the data (curiously) are good enough to eliminate any concern.

We think the data justify extensive follow-up monitoring, and are concerned about these hot spots. But a battle of data anlysis is not necessary in order to draw several conclusions: (1) EPA has now admitted that it did not comply with its obligations to identify areas needing more serious attention; (2) EPA will not be in a position to publish strategies by December for addressing hot-spot problems; and (3) EPA is trying to duck all of these obligations by asking the court to eliminate them.

C. The Pretreatment Shell Game.

As you know, the Clean Water Act requires EPA to promulgate pretreatment standards for industrial facilities which dispose of their wastewaters into municipal sewage plants. EPA chose to implement this requirement in two concurrent phases. The first phase consisted of "general" pretreatment regulations defining the basic structure of the program. These regulations outlined the roles which EPA, state and local government, industry, and the public will play in the national pretreatment effort. They defined deadlines for action, monitoring requirements, procedures for obtaining exceptions to the general rules, and EPA's enforcement policy. In separate proceedings under the consent decree, EPA is developing "categorical" pretreatment standards which establish specific discharge limits for industrial facilities. Both the general and categorical regulations are an integral part of the pretreatment program since together they define the conditions under which industrial wastes may be dumped in municipal sewage treatment plants.

The general pretreatment regulations are the culmination of four years of administrative rulemaking. Issued first in 1978 and then amended in early 1981, they were abruptly suspended by EPA three days after they became effective without notice or opportunity for public comment. Moreover, EPA made its decision after extensive secret lobbying from industries affected by the regulations.

At least 60,000 industrial facilities dispose of their wastewaters in municipal treatment plants. These indirect polluters generally contribute only a small part of the flow to municipal treatment works, but are responsible for as much as 67% of the total toxic metals entering a typical system, and as much a 80-95% of certain highly toxic pollutants. Toxic pollutants frequently found in industrial effluent may be carcinogenic, mutagenic, teratogenic, or acutely toxic to humans and aquatic organisms. They include cadmium, which can cause kidney damage and chronic respiratory problems; lead, which damages the nervous system, especially in children; and mercury, which can cause bronchitis, brain damage, and loss of hearing and vision.

The general pretreatment regulations to address these pollutant problems were first proposed on February 2, 1977. Following the proposal, EPA compiled an exhaustive administrative record which included over 400 individual comments, 4 public hearings, and 16 public meetings with state and local governments, industry, environmental, consumer and other public interest organizations. Congress also entered the debate, reconsidering the Clean Water Act during the last half of 1977 and focusing in particular on the pretreatment program. Congress especially criticized the slow pace of EPA implementation of the program, emphasizing its importance to the overall water pollution clean up effort.

When NRDC and several industry parties filed suit challenging aspects of the regulations, EPA signed a settlement agreement with industry. (NRDC was not a party to the settlement since EPA did not address any of NRDC's concerns.) The settlement obligated EPA to repromulgate amendments to the regulations promptly.

EPA took over a year and a half to finalize the amendments. During this period, EPA permitted three sequential public comment periods totalling over 4-1/2 months, spent almost a year reviewing the results, and reevaluated its economic impact analysis before promulgating final amendments to the general pretreatment regulations on January 28, 1981.

The day the general pretreatment regulations were reissued, industry intervenors began a secret and concerted campaign for their repeal. Before March 24, 1981, EPA, the Presidential Task Force on Regulatory Relief, and the Office of Management and Budget (OMB) received at least twelve substantial *ex parte* communications on the regulations. These *ex parte* communications reveal two significant facts about EPA's decision-making process. First, EPA took the position that the 1981 amendments to the general pretreatment regulations were "minor" rules, not subject to regulatory review under Executive Order 12291, and ought not to be suspended. Second, industry intervenors, apparently unsuccessful with EPA, pressured OMB and the Presidential Task Force on Regulatory Relief to override EPA's decisions. Thus, CMA's letter of March 19, 1981 offered OMB this advice:

> [W]e continue to urge that the EPA general pretreatment regulations be treated as a major rule, and be subject to regulatory review and a suspension pending such review insofar as they address the problem of pretreatment limits for integrated facilities and removal credits. We believe that this issue is an important precedent under the Executive Order. If these regulations are exempted under the Executive Order, some real questions will be raised as to the extent to which the Administration intends to follow up on its commitments for regulatory review of rules that impose a major impact on industry, the economy, and state and local governments. We hope that these issues will be given careful scrutiny by the Task Group.

Another CMA letter, also dated March 19, 1981, to C. Boyden Gray, counsel to the Task Force on Regulatory Relief, was even more explicit:

> I am writing to express my grave concerns with EPA's recent recommendation that the general pretreatment regulations be exempted from Executive Order 12291 as a "minor" rule ... We strongly recommend that the Task Force on Regulatory Relief categorically reject EPA's recommendation, and direct EPA to carry out the required review. Any other action on a program of this magnitude and significance to industry and municipalities would seriously jeopardize the utility and effectiveness of the Task Force's implementation of Executive Order 12291. This matter is so important to the chemical industry and the regulatory reform program in general that we would like an opportunity to discuss with you the general pretreatment regulations and their impact before any Task Force decision is made.

Shortly after these comments reached OMB and the Presidential Task Force, EPA reversed its earlier decision. On April 2, 1981, three days after the amendments to the general pretreatment regulations took effect, EPA suspended the amendments "until further notice." Unlike earlier agency actions which had been accomplished with ample opportunity for input from all sectors of the public, the suspension was undertaken without any notice or opportunity for public comment. Silent as to its reasons, EPA noted only that: "This action is taken pursuant to Executive Order 12291."

Relying upon its suspension of the 1981 amendments to the general pretreatment regultions, EPA then took a series of actions with immediate and significant environmental consequences. First, EPA advised the electroplating industry that it could postpone efforts to comply with applicable "categorical" pretreatment standards. EPA told "integrated" electroplating facilities (i.e., those which combine their electroplating wastestreams with other wastestreams before discharge to a municipal plant) that they need not comply until EPA took further action on the pretreatment regulations. EPA also advised "non-integrated" facilities (those which do not combine wastestreams) that they could have an additional nine months to meet the standards.

Second, EPA suspended regulations which required local municipalities to develop and obtain federal approval of a pretreatment program before receiving federal grants to construct sewage treatment plants. EPA advised municipalities that they need not comply with these requirements "until EPA makes a final decision on pretreatment program requirements."

Third, EPA extended the schedule for review of the pretreatment regulations. Having previously advised the Third Circuit that review could probably be accomplished "within four months," EPA has now announced that its regulatory analysis will not be completed until April, 1982, a year and three months after these regulations were promulgated. If EPA decides to revise the regulations after completing its analysis, regulations will not be finalized until late 1982 or 1983, and possibly well beyond the Clean Water Act's 1983 deadline.

Finally, on October 13, 1981, EPA published another extension of the regulations until January 31, 1982, and simultaneously proposed to extend them indefinitely. This new move was designed to affect NRDC's litigation challenging the earlier suspension. As one EPA official put it, the Agency "didn't have a chance" against the NRDC suit. He continued: "We were advised by Vice President Bush's Task Force on Regulatory Relief to delay the effective date, and procedural niceties were not involved." (BNA, Environment Reporter, Current Developments at 744 (October 16, 1981).

III. Where Is EPA Heading With This Program?

As I mentioned at the outset, EPA is taking unilateral steps to delay this program and to alter its scope and direction. Through the budget process, EPA is developing plans to embark on a new, unworkable approach to toxics control -- the very approach abandoned by Congress nearly a decade ago.

A. The Stretch-Out Strategy.

The EPA staff briefing memorandum (mentioned above) reveals the Agency's strategy to delay and alter the toxics program:

> EPA could move to modify the decree to adopt industry's proposed revisions and at the same time incorporate new realistic schedules for issuing the regulations covered by the decree ([footnote:] EPA could also seek to narrow the categories of industries covered by the decree.) Under such an approach, the Administrator would have increased flexibility to determine the strategy for controlling industrial pollution although there would continue to be some constraints. These constraints could, however, be minimized if in proposing revised schedules the Agency took into account present and expected levels of funding for this program. Given the decree, we are

> more likely to prevail in establishing an extended "stretched-out" schedule justified by resource contraints than in avoiding any schedule at all.

(Emphasis added). What does this suggest to you?

The memorandum suggests to us that EPA views the consent decree (as well as similar provisions in the Clean Water Act), not as a mandate, but as merely constraints on the Administrator's freedom to pursue a different course -- or no course at all. "Industry's proposed revisions," noted in the memorandum, simply would eliminate much of the program. The memorandum also suggests to us that EPA's attempt to be rid of the court-ordered constraints is disingenuous. It is not premised on budget cuts. It is a policy decision to change the law -- a decision EPA now attempts to justify by reference to budget cuts.

This inference is confirmed by the Agency's FY 82 budget submissions to the House Committee on Appropriations. In a (now published) hearing before the Committee on April 1, 1981,[5] Acting Administrator Walter Barber presented the Agency's proposed cuts for the Effluent Guidelines program (to these figures, we have added EPA's FY 83 request):

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[5] Dept. of Housing and Urban Development -- Independent Agencies Appropriations for 1982, Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, 97th Cong., 1st Sess. (1981).

TABLE 2 (dollars in thousands)

	Actual 1980	Estimate 1981	Estimate 1982	Request 1983
Funds	26,464	30,045	16,070	12,160
Positions	108	112	85	68

The FY 83 request for funds is only 40% of the FY 81 estimate, and the personnel level would be only 60% of EPA's estimated strength in FY 81.

At a time when only one guideline out of 34 has been issued, why would EPA make such drastic cuts? EPA's written justification explains it: "This decrease reflects a policy decision to promulgate Effluent Standards and Guidelines over a longer time-frame ...,."[6/] (emphasis added). The Agency apparently made a policy decision in early 1981 to delay this program, and then sought reduced funding on that basis. Now we learn that EPA has reduced even this level by an additional $4 million and 16 positions for FY 83.

The inevitable result of these cuts is the delay EPA intended. The Agency's proposed schedule would call for 8 regulations to be issued in 1983, including: Organic Chemicals and Plastics (5/83); Nonferrous Metals (Phase I) (11/83); Foundries (10/83); and Battery Manufacturers (7/83). Another 8 would be promulgated in the last half of 1982. Only seven rules would be promulgated prior to June of next year.

6/ Id. at 379, 386.

These delays are guaranteed to prevent industries from complying with their July 1, 1984 statutory deadline. EPA has stated many times that writing an industrial permit takes an average of 9-12 months. And industrial facilities obviously need many months, perhaps years, to purchase and install the necessary treatment equipment.

We think the implications of EPA's "policy decision" are as obvious as they are serious. The Agency has decided to grant industries a *de facto* extension by delaying its own guidelines program.

B. *The Non-Permit Strategy*.

EPA does not have to wait until the guidelines are final in order to issue permits for toxic industrial dischargers. By using the wealth of engineering and cost data compiled over the last five years to support the guidelines, permit writers can issue case-by-case effluent limits, under § 402(a)(1) of the Act, using their "Best Professional Judgment" (BPJ) Section 402(a)(1) was placed in the law precisely to avoid stretching out compliance where guidelines are delayed. Most of the BPT permits were issued in this manner, and until recently, EPA's Consolidated Permits Regulations *required* that any permit issued after June 30, 1981 must have BAT-toxics limitations whether or not a guideline had been issued. 40 C.F.R. § 122.62(c)(2).

In its FY 82 budget testimony last April, EPA stressed that its permitting resources would be used to issue these major toxics permits:

> Virtually all of these resources will be used for the control of direct or indirect toxic discharges. Control of direct toxic dischargers will be achieved by imposing new and more stringent controls on industrial dischargers through the issuance of "second round" permits using BAT guidelines or, in the absence of guidelines, using BPJ. The Clean Water Act mandates that industries meet toxic standards by July 1984. Of the one thousand major nonmunicipal permits EPA will issue in 1982, about seven hundred will be to industries covered by the NRDC consent decree.[7]

But then something changed abruptly. On July 15, 1981, EPA proposed to amend its regulations by extending the June 30, 1981 deadline (for issuing BPJ permits) until December 31, 1982.[8] And in its September budget submission for FY 83, EPA cut its resources for permit issuance drastically:

TABLE 3
(dollars in thousands)

	Actual 1980	Estimate 1981	Estimate 1982	Request 1983
Funds	9,790	13,876	14,957	10,129
Personnel	229	242	204	164

From FY 82 to FY 83, funds were cut by one-third, and staff positions were reduced by nearly 18 per cent.

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[7] Hearings, House Committee on Appropriations, supra note 5, at 436.

[8] 46 Fed. Reg. 36719 (July 15, 1981). We are informed by EPA that a final rulemaking package on this change has been prepared.

Why? Because EPA apparently has decided not to issue BPJ permits for any industries expected to have guidelines in the next several years: "The decrease reflects the elimination of Best Professional Judgment permit issuance support for industry categories which will later have BAT guildelines.[9/]

The Agency simply has eliminated its only remaining means of securing compliance with the July 1, 1984 BAT deadline. It's Non-Permit Strategy, coupled with its Stretch-Out Strategy, effectively and unilaterally amend the Clean Water Act.

C. The Long, Rocky Road to Disaster: A Reversal of Congressional Policy.

Unfortunately, these alterations of the Act's BAT-toxics strategy only scratch the surfce. Delays in the effluent guidelines and permit programs lay the groundwork for a long-term reversal of Congress' decision to control industrial toxics through technology-based limitations. EPA now plans to resurrect the old water quality-based, site-specific approach despite its acknowledged inability to address toxics problems.

EPA's FY 83 Decision Unit Analysis for the Research and

9/ EPA FY 83 OMB Request, Water Quality Media Overview, at p. 12.

Development program reveals this new strategy.[10/] In its introduction, the Analysis states:

> The overall goal of the Water Quality Research Program is to provide the scientific information, techniques, and support functions ... to address ambient water quality problems on a local or regional basis from a cost-effecctiveness/cost and risk-benefit perspective. This will allow a departure from use of uniform national water quality goals and best available technology as the basis for establishing pollution control requirements for each discharger.

(emphasis added).

Under the heading of "CURRENT OPERATIONS," the Analysis then states: "The basic underlying premise on which this research program rests is that as a result of past implementation of technology based pollution control requirements, current emphasis is and will remain on a water quality based approach." (emphasis added). As the Committee knows, the only "past implementation" ever accomplished by EPA was BPT controls on conventional pollutants and a handful of heavy metals. Because of the BAT stretch-out described above, this new "current emphasis" is well designed to replace Congress' BAT toxics strategy.

This new strategy apparently originated in the water program office. On July 17, 1981, Dr. Andrew P. Jovanovich, Acting Assistant Administrator for R&D, forwarded his budget request to the Administrator under a transmittal memorandum (attached) that summarized his new directions for research. "It is with great pleasure," Dr. Jovanovich said, that he offered a program that had been "critically reviewed ... for

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[10/] United States Environmental Protection Agency, Decision Unit Analysis, DU CODE B107 (September 11, 1981).

inconsistency with [the Administrator's] budget guidance." Further, he was "confident that [she] will find ORD's budget proposal to be consistent with the policies of the Administration." Under "WATER QUALITY MEDIUM," Dr. Jovanovich reveals that, as a policy matter, BAT controls are being abandoned:

> The focus of the base water quality research program is on facilitating the program office's policy shift of controlling of pollution sources on the basis of potential benefits to improving water quality as opposed to point source control using best available technology. Much of the research will be aimed at giving the States the tools to make this shift.

(emphasis added). The policy shift seems clear enough. But what are those tools, and when will the States have them?

EPA's Analysis recites the primary factors that would be necessary for such an approach to work -- precisely the reasons why Congress rejected this approach:

> EPA and State and local pollution control agencies must be able to: 1) quickly and inexpensively identify human-induced water quality problems, especially those caused by toxic pollutants; 2) identify the beneficial water uses that are feasible to attain; 3) select water quality goals and standards for each area that truly reflect (i.e., without either excessive or inadequate factors of safely) the water quality necessary for intended beneficial uses; and 4) identify the most cost-effective pollution control strategy for achieving or maintaining the applicable goals or standards.

These are the very tasks that no one can perform at present, and EPA's Analysis explains why:

> ° "there are stll no reference methods ... [for measurement of Consent Decree pollutants] applicable to marine waters, sediments or fish tissue."

- "There are no low-cost practical screening techniques to scan large numbers of samples for the presence or absence of toxic pollutants in toxic amounts."

- "existing reference methods for toxic metals are not sufficiently sensitive."

- "[there is an] inability to measure effluent discharge flow at the necessary level of precision to calculate receiving water impacts (and, therefore, waste treatment requirements to protect water quality)."

- "existing models are inadequate for making wasteload allocations of the priority toxic pollutants."

- "there are essentially no data available for assigning values to proposed incremental improvements in water quality, as would be essential in determining the highest level of water quality worthy of pursuit in a given stream reach."

Instead of concluding (as Congress did many years ago), that these deficiencies require a prompt, prudent technology-based approach for toxics, EPA has decided to charge down this long road anyway. And they have devised a research and development program to take a meager first step. When will the effort succeed? EPA's Analysis says:

> At the FY 1981 level (and assuming zero inflation), the needed technical base could be completed, but not field validated, by approximately 1990.

But under the current budget reductions of 58% in funds and 24% in personnel between 1981 and 1983 (see Table 4), and not ignoring inflation, this program may never succeed.

TABLE 4
WATER QUALITY R&D
(dollars in thousands)

	Actual 1981	Budgeted 1982	Requested 1983
Funds	24,341	18,291	10,186
Personnel	365	338	277

What happens in the meantime? Aside from a number of quick and dirty toxics criteria,[11/] the result will be a bundle of unanswerable questions. According to EPA's Analysis:

> The primary impact of the deficiencies will be to cause EPA and State and local pollution control agencies to potentially miss significant water quality problems (because ambient water quality monitoring is either too expensive or the methods don't exist for the pollutants in question) .... As a result, the states and EPA may not know what or where their worst water pollution problems are; the types of remedial actions that would be most cost-effective; the improvements resulting from past Agency/State efforts and expenditures ....

(Emphasis added).

[11/] EPA Plans to develop "mini data sets (i.e., effects data on only two or three animal species, to give only a rough approximation of degree of toxicity) and gross screening data on health and ecological effects." These will be needed in FY 83, EPA says, "on approximately 10 to 20 potentially toxic pollutants that are expected to be identified ... as warranting concern." Ultimately, EPA says the number may approach 80 such pollutants in FY 83.

That is the program to which we can look forward over the next decade. It is directly contrary to the Clean Water Act's mandate. It will not work, if at all, for many years. And during the interim the pollution consequences of this program may prove to be serious indeed, even though EPA will not have a clue how serious.

* * *

As members of Congress, _you_ and your colleagues in the Senate are responsible for the policy direction of this national toxics program. You have not left it to the Administrator to unilaterally and secretly turn that program upside down. This Committee's oversight function is critical. We urge you to pursue it as far as necessary to restore the Clean Water Act's fundamental approach to pollution control.

Natural Resources Defense Council, Inc.
1725 I STREET, N.W.
SUITE 600
WASHINGTON, D.C. 20006
202 223-8210

New York Office
122 EAST 42ND STREET
NEW YORK, N.Y. 10168
212 949-0049

Western Office
25 KEARNY STREET
SAN FRANCISCO, CALIF. 94108
415 421-6561

March 29, 1982

Mr. James F. Davey, Clerk
U.S. District Court
for the District of Columbia
Room 1825 U.S. Courthouse
Constitution Avenue & John Marshall Place, NW
Washington, D. C. 20001

Re: NRDC v. Gorsuch, Nos. 2153-73, et al.,

Dear Mr. Davey:

Enclosed are one original and four copies of Plaintiffs' Memorandum In Opposition to Defendants' Cross-Motion To Modify Consent Decree for filing in the above-captioned case.

Sincerely,

J. Taylor Banks

J. Taylor Banks

Encls.

CC: All Parties

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

NATURAL RESOURCES DEFENSE COUNCIL, INC.
et al.,

Plaintiffs,

v.

ANNE M. GORSUCH, Administrator
Environmental Protection Agency, et al.

Defendants

and

UNION CARBIDE CORP., et al.,

Intervenors.

Civil Action Nos.
2153-73
75-0172
75-1698
75-1267

PLAINTIFFS' MEMORANDUM IN OPPOSITION TO DEFENDANTS' CROSS-MOTION TO MODIFY CONSENT DECREE

J. Taylor Banks
Attorney for Plaintiffs
Natural Resources Defense Council, Inc.
1725 I Street, N.W., Suite 600
Washington, D. C. 20006
(202) 223-8210

March 29, 1982

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INTRODUCTION AND SUMMARY

The Court's ruling on this motion will determine the pace and future scope of this Nation's toxic water pollution control effort under the Clean Water Act, 33 U.S.C. § 1251, et seq. ("the Act"). Defendants Environmental Protection Agency and EPA Administrator Anne Gorsuch seek major revisions to the Settlement Agreement and the Court's order[1] that would stretch out much of that effort and eliminate the remainder. If the Court grants these requests, the quality of water in this country will suffer from EPA's delays. The ability of the judicial process to move a reluctant agency will have suffered as well.

The Court is intimately familiar with this Consent Decree and with the importance of its interrelated provisions. Its purposes and basis have been examined on three occasions when the Court considered challenges to the Decree raised by Intervenors. Accordingly, we will not describe the Consent Decree program in detail, but address generally only those provisions of central importance to this motion.

In August 1981, EPA moved pursuant to Rule 60(b) F.R.C.P. to modify the Consent Decree, and then on March 5, 1982 amended its motion to increase the delays being requested. EPA wishes to extend the deadlines of paragraph 7 for promulgating categorical, industrial regulations out to mid-1984; to delete from the Decree its obligations to address toxics problems left uncontrolled by those regulations; and to eliminate its duty to regulate several major industries. Each of these requests would severely impair the cohesive program for which Plaintiffs exchanged their litigation rights in 1976. And each would mortgage the future of this comprehensive toxics program.

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[1] Natural Resources Defense Council v. Train, 8 ERC 2120 (D.D.C. 1976), as modified, NRDC v. Costle, 12 ERC 1833 (D.D.C. 1979).

With the Court's assistance, and with prompt cooperation by Defendants' counsel, Plaintiffs have conducted discovery to ascertain the nature and validity of Defendants' basis for their motion. Although the Court denied the potentially most useful portions of Plaintiffs' discovery, the exercise did sharpen the issues considerably. In successive responses to Plaintiffs' inquiries, EPA's theory has evolved in some areas and changed dramatically in others. Much of the information furnished through discovery has been quite useful.

Plaintiffs emphatically urge the Court to deny EPA's motion to amend the Decree. The applicable legal standard is strict, and Defendants have not carried the heavy burden of justifying their requests. EPA has not suffered any extreme hardship, and is not presently faced with an impossible task of compliance.

Rather, Defendants have manufactured most of their "changed circumstances" through proposed budget cuts, internal resource allocations, and decisions to pursue extraneous processes that are neither sanctioned by law nor necessary for sound rulemaking practices. Plaintiffs believe EPA planned to delay and diminish the Consent Decree program, and then set about to do so outside this litigation. The requested modifications would implement that plan, but they would thwart the fundamental purposes of this Court's order.

For these reasons, Plaintiffs request that EPA's amended motion to modify the Decree be denied entirely. Further, Plaintiffs recommend that the Court require Defendants to promptly submit revised schedules that meet specific restrictions and conditions, as outlined in Plaintiffs' proposed order. Plaintiffs' recommended procedures should produce substantial compliance with much of Defendants' obligations within one year.

ARGUMENT

I. The Legal Standard and the Court's Inquiry

There is no question that this Court has the inherent power to modify its final decree. Decrees are judicial acts that must be implemented with enough fairness and flexibility to effectuate their purposes in light of circumstances surrounding the litigation.

The modification of a decree is extraordinary relief, however, and the Court's discretion and authority to revise its orders must not be lightly exercised. EEOC v. Safeway Stores, Inc., 611 F.2d 795, 799 (10th Cir. 1979), cert. denied, 446 U.S. 952 (1980); United States v. Work Wear Corp., 602 F.2d 110 (6th Cir. 1979); Mayberry v. Maroney, 558 F.2d 1159, 1163 (3d Cir. 1977); DePilippis v. United States, 567 F.2d 341 (7th Cir. 1977). The standard is a strict one, requiring a showing of "exceptional circumstances" to justify relieving a party of its obligations. Philadelphia Welfare Rights Org'n. v. Shapp, 602 F.2d 1114, 1119 (3d Cir. 1979).

Because of the interest in finality of judgments, this strict standard necessarily imposes a heavy burden of proof on the party seeking modifications. United States Steel Corp. v. Fraternal Ass'n of Steel Haulers, 601 F.2d 1269 (3d Cir. 1979). That burden is made even heavier when the judgment was entered on consent. As the court observed in United States Steel, "when, as in this case, the appellant made a free, calculated and deliberate choice to submit to an agreed upon decree rather than seek a more favorable litigated judgment, their burden under Rule 60(b) is perhaps even more formidable than had they litigated and lost." 601 F.2d at 1274; see also Philadelphia Welfare Rights Org'n., 602 F.2d at 1120.

The courts are in close accord on the standards to be applied in this case. They emphasize both a reluctance to disturb final judicial orders and a commitment to upholding the hard-fought bargains embodied in consent decrees. As we demonstrate below, the standard, as well as its application to specific circumstances, are much more rigorous and demanding than Defendants' simple characterization of the Court's discretion to "apply modifed measures to changed circumstances." (Defendants' Memorandum ... in Support of Cross-Motion to Modify, 27)(hereinafter "Def. Mem.")).

A. The Standard for Ruling on Motions to Modify.

Whether the Court acts under Rule 60(b) or its inherent equitable powers, the accepted legal standard in this case requires three related inquiries. First, the Court should examine the effects on EPA of continued application of the Decree's requirements. Second, the Court must consider the effects of any proposed modification on the Decree's purposes and the goals of the Act. Third, for requests to eliminate portions of its final order, the Court must consider whether the harm still exists that the Decree seeks to remedy. In the course of these three inquiries, the Court is guided by additional standards under which to assess the Defendants' conduct and the excuses they have offered for seeking modifications.[2/]

From the outset, the Decree has imposed regulatory constraints on EPA from which it would prefer to be free. The accepted standard, however, requires that EPA show egregious and debilitating burdens to justify its motion. Defendants must demonstrate that circumstances have changed such that the Decree has been turned into an "instrument of wrong." United States v. Swift & Co., 286 U.S. 106, 114-115 (1932); United States v. Motor Vehicle Mfrs. Ass'n, 643 F.2d 644, 649 (9th Cir. 1981). There must be a showing of "exceptional circumstances or a grievous wrong evoked by new and unforseen conditions." DeFilippis v. United States, 567 F.2d 341, 342 (7th Cir. 1977). In short, the changed circumstances on which

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[2/] See discussion regarding application of these standards at 5-10, infra.

EPA relies must do more than merely cause inconvenience; they must have produced "hardship so extreme and unexpected as to make the decree oppressive." EEOC v. Safeway Stores, Inc., 611 F.2d 795, 800 (10th Cir. 1979) (quoting Swift, 286 U.S. at 119); Mayberry v. Maroney, 558 F.2d 1159, 1163 (3d Cir. 1977).

EPA agrees that the Court also must determine whether the requested modifications would better serve the Decree's purposes and the purposes of the Act. (Def. Mem., 27). The Court should decide whether these suggested changes would "serve[] to effectuate or thwart the basic purpose of the original consent decree." Chrysler Corp. v. United States, 316 U.S. 556, 562 (1942); United States v. Motor Vehicle Mfrs. Ass'n, 643 F.2d 644, 649 (9th Cir. 1981). In so doing, the Court should be cognizant of the parties' purposes and the objectives of the Act from which the Court derives its basic authority. Motor Vehicle Mfrs., 643 F.2d at 650.

Finally, since the Court is petitioned to vacate portions of the Decree, it must satisfy itself that those portions no longer are justified and necessary to prevent the harm to which the Decree is addressed. The Court may modify a decree "when the danger which the decree sought to prevent has been 'attenuated to a shadow.'" Philadelphia Welfare Rights Org'n v. Shapp, 602 F.2d 1114, 1120 (3d Cir. 1979) (quoting Swift, 286 U.S. at 115); Mayberry v. Maroney, 558 F.2d 1159, 1163 (3d Cir. 1977).

B. Application of the Standard

In applying these principles, the Court is called upon to examine both the Defendants' conduct and the validity of their claim that exceptional circumstances warrant these modifications. Especially against a background of total noncompliance, the Court of Appeals for this Circuit has issued its admonishment to "scrutinize ... [defendants' assertions] carefully since officials may seize on a remedy made available for extreme illness and promote it into the daily bread of convenience." NRDC v. Train, 510 F.2d 692, 713 (D.C. Cir. 1974).

The Court's ability to influence Defendants' ongoing conduct by defining their future obligations is the central issue in this case, and it is critically important to the integrity of these environmental programs. In Illinois v. Gorsuch, 16 ERC 2021 (D.D.C. 1981), for example, Judge Gesell recently drew the line on EPA's continuous footdragging and offers of excuses in implementing the Resource Conservation and Recovery Act (RCRA). Judge Gesell rejected the same excuses offered by EPA in this proceeding,[3] and ordered Administrator Gorsuch to promptly issue regulations for hazardous waste disposal facilities. After denying the government's motion for reconsideration, Judge Gesell issued a brief stay pending appeal, and in his opinion emphasized the relevancy of EPA's prior conduct:

> What Congress directed be done is now almost four years overdue and the Environmental Protection Agency contemplated at least two more years of indecision and procrastination. Congress has taken no positive action when the situation has been brought to its attention. The Agency, moreover, has ignored the Court's deadline orders, offering excuse after excuse for avoiding its responsibility to publish these regulations as Congress directed. The Agency has demonstrated that it has neither the ability nor the will to do what Congress asked and the Court repeatedly ordered. The Court can do no more and will not reconsider its Order further.

Id. (order issued Jan. 28, 1982) at 2.[4]

Similarly in Environmental Defense Fund v. Gorsuch, Civ. Action Nos. 81-2083, 81-2269 (D.D.C., orders dtd. Feb. 12, 1982 and Mar. 19, 1982), Judge Pratt refused to sanction EPA's excuses for delaying revisions to the National Contingency Plan and emergency guidelines required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, commonly known as "Superfund"). These actions were nine months overdue. The Court brushed aside as "diversionary" the excuses and objections EPA offered to prevent an expeditious compliance schedule, and required action within 60-90 days. (Slip Op. dtd. Feb. 12, 1982, at 4-6).

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[3] See discussion at 10, infra.

[4] In March, the Court of Appeals for the D.C. Circuit issued a short stay so the parties could brief and argue the appeal according to an expedited schedule. Illinois v. Gorsuch, Civ. No. 82-1039 and consolidated cases (D.C. Cir., order issued Mar. 16, 1982). On appeal, EPA contends that it is physically unable to meet the court's two and one-half month schedule.

Defendants' ongoing conduct is central here, for they cannot invoke this Court's equitable authority without clean hands. Parties whose obligations are defined by court order must make diligent efforts to comply. United States v. Swingline, Inc., 371 F.Supp. 37 (E.D.N.Y. 1974). They must take "energetic steps to see that the orders of the court were carried out." Id. at 44-45. And those steps must include every reasonable action within the Defendants' power to effect. They must "marshal their own resources, assert their high authority, and demand the results needed from subordinate persons and agencies." ASPIRA v. Board of Education, 423 F.Supp. 647, 654 (S.D.N.Y. 1976).

Likewise, EPA's excuses must pass muster under strict judicial standards. Defendants cannot escape their responsibilities unless, despite their proper and diligent conduct, circumstances have eliminated their options and rendered them "powerless to comply." NRDC v. Train, 510 F.2d 692, 713 (D.C. Cir. 1974).

In Brown v. Neeb, 644 F.2d 551 (6th Cir. 1981), for example, the city of Toledo faced economic problems prompting it to lay off minority firefighters despite an outstanding consent decree requiring the fire department to achieve a specific racial goal. Ohio law not only prohibited a budget deficit, but also required that layoffs be made on the basis of seniority -- disproportionately affecting black and Hispanic firefighters, most of whom had been hired recently. The district court enjoined the layoffs because they would erase most of defendant's progress under the consent decree to that point.

On appeal, the Sixth Circuit affirmed. Relying on the district court's authority to modify its decree, the court upheld the remedy despite the original decree's failure to even address layoffs. The city was not required to violate Ohio law; it could balance its budget by cutbacks in other areas, or simply decline to lay off any firefighters. Id. at 563. In short, the city had options, and was not rendered powerless to comply with the original consent decree.[5/]

Similarly, one of the most important restrictions on Defendants' excuses is that they cannot, by commission or omission, manufacture their own "changed circumstances" or simply change their mind about the wisdom of relief to which they agreed. The Third Circuit's opinion in Mayberry v. Maroney, 558 F.2d 1159 (3d. Cir. 1977), illustrates these principles. A class action was brought against the Pennsylvania Correctional Institution, and a consent decree was entered under which defendants agreed not to confine prisoners to a basement detention facility at Western Penetentiary. After ten months, defendants resumed use of the facility on a more limited (48 hours) basis of confinement, and moved pursuant to Rule 60(b) for a modification of the decree to permit such use. The district court granted defendants' motion, but on appeal the Third Circuit reversed.

5/ Compare Philadelphia Welfare Rights Org'n v. Shapp, 602 F.2d 1114 (3d Cir. 1979). In Shapp, the court granted the defendant's motion to modify an outstanding decree because despite good-faith efforts, circumstances ouside their control had placed compliance beyond their reach.

The primary "change of circumstances" offered by defendants had been that "recourse to the basement facility on an emergency or crisis basis is essential to the orderly management of Western Penetentiary." 558 F.2d at 1163. Finding that *conditions* had not materially changed, the court rejected this excuse:

> The Commonwealth may not now artificially create its own "changed circumstances" and thus relieve itself from a free, calculated and deliberate choice, by offering a substitute remedy which provides a lesser safeguard against the injuries complained of .... Obviously, this alternative remedy would be more convenient for the Commonwealth [footnote omitted] .... But in the words of Mr. Justice Cardozo, "*[w]e are not framing a decree. We are asking ourselves whether anything has happened that will justify us now changing a decree* ...." *Swift & Co.*, 286 U.S. at 119. Rather than this manufactured "changed circumstance," we would think it relevant to show that the physical conditions existing in the [basement facility] had been improved ....

Id. at 1164. Moreover, the court was not sympathetic to the defendants' apparently new-born realization that better management required relief from the decree: "The Commonwealth 'cannot be relieved of such a choice because hindsight seems to indicate to [it] that [its] decision ... was probably wrong .... There must be an end to litigation someday, and free, calculated, deliberate choices are not to be relieved from.'" [citation omitted]. *Id.*

Defendants also cannot rely on puported legal barriers or collateral burdens as excuses to justify a modification. This is true especially where an agency has substantial control over its options to allocate resources and adjust priorities. *See* *Brown* v. *Neeb*, 644 F.2d 551 (6th Cir. 1981). It is no excuse that an existing decree imposes obligations more extensive than those of the underlying statute, or more specific than could have been obtained after complete litigation of the issues. *EEOC* v. *Safeway Stores, Inc*. 611 F.2d 795, 799-800 (10th Cir. 1979); *Coalition of Black Leadership* v. *Cianci*, 570 F.2d 12 (1st Cir. 1978).

Finally, there must be limits on Defendants' ability to delay compliance in order to address all possible technical and policy issues that might arise. Given the complexity and interrelated nature of environmental regulations, EPA could delay virtually forever to iron out every conceivable wrinkle. These delays are inconsistent with Congress' consistent mandate to move promptly against environmental hazards, and cannot be sanctioned indefinitely.

Judge Gesell finally said "no" to this category of excuses in Illinois v. Gorsuch, 16 ERC 2021 (D.D.C. 1981). There, the Administrator offered much the same arguments for delay under RCRA that are presented in this case under the Clean Water Act. Judge Gesell said:

> a further extension is not warranted. In her report the Administrator states that regulations governing land disposal of hazardous wastes raise technical and policy issues of great complexity and the Agency's prior research and anlysis, conducted for the most part under the supervision of the prior Administrator, do not provide an adequate basis for resolving these issues. The fact that RCRA directs the Administrator to promulgate regulations within eighteen months of the Act indicates that Congress did not direct the Agency to resolve every conceivable problem before issuing regulations. In the more than five years since RCRA was enacted the Agency has had the opportunity to consider various regulatory approaches and numerous comments and suggestions by the affected interests. The Agency may fulfill its mandate to issue regulations as well as satisfy its lingering technical and policy concerns by issuing regulations and later consider revision if the Agency's understanding and expertise expand.

Id. at 2024 (emphasis added throughout unless otherwise indicated).

In the next section, we examine EPA's numerous excuses and "changed circumstances" under the established standards. Except for technical and data problems, we believe those excuses fail totally to justify Defendants' requests for further delays and deletions from the Court's order.

II. EPA's Conduct and Excuses Fail to Meet the Legal Standard.

None of the many reasons offered by Defendants comes anywhere near justifying the requested modifications. EPA has been before this Court numerous times with these and other excuses, and despite the Court's and the plaintiffs' indulgence, has not met any of its obligations. Patience has not moved this Agency; it has resulted in further delays and now, at the eleventh hour, requests to abandon many of EPA's obligations altogether.

In the discussion below, we examine each of Defendants' varied (and shifting) excuses for seeking this relief. We first address EPA's reasons for delaying industrial categorical regulations under Paragraph 7 of the Decree. Next we examine the Agency's justification for seeking total relief from most of its remaining obligations, and from its duty to promulgate other categorical regulations.

A. Delay of Categorical Industrial Regulations.

EPA's motion, as amended, seeks to delay the issuance of 24 categorical regulations under Paragraph 7. On the average, these delays would extend the original Consent Decree dates by nearly four years, the modified Decree's dates by over two years, and the dates contained in EPA's August motion by up to 13 months. All but eleven of these regulations were issued in proposed form as long as 33 months ago.[6/] The amended schedule would permit some of the most important regulations to be delayed until only a few months remain prior to the industrial dischargers' statutory compliance deadline of July 1, 1984. 33 U.S.C. § 1311(b)(2)(C).

Despite EPA's proliferation of affidavits, management tracking systems and schedules, it is obvious that not all of

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6/ *See* Affidavit of Lewis S.W. Crampton ("Crampton Aff.") at 3, par. 6. Five of these rules were proposed in 1979; six were proposed in 1980; and the most recent was proposed in January 1981, over a year ago.

these delays are needed. The Agency is not faced with hardship or oppression; it simply wishes to take its time. It has not carried the heavy burden required to justify these extensions.

A few months after EPA's August motion, Plaintiffs obtained an EPA staff document showing the status of, and prognosis for most of these regulations.[7/] The document advised high-level Agency officials of the technical status and problems with each industry, and forecast whether the August EPA schedule could be met.

The document indicates that out of 21 "High Priority" industries, serious problems existed for only two categories: Copper Forming (poor contractor performance); and Photographic Equipment and Supplies (no funding). For the remaining 19 industries, EPA's technical experts saw no major reason (or in some cases remote possibilities)[8/] why the deadlines proposed in August could not be met. The document states, for example:

> Battery Manufacturing ... The schedule proposal date ... is June 18, 1982. This date should definitely be met and perhaps moved up with the availability of contractor support, and the reduction of extended Agency reviews.
>
> Coil Coating ...[I]ndustry comments recommended limits very similar to those being developed. There are no other known problems or issues .... No problems are seen in meeting or exceeding the schedule to promulgate these rules before October 1, 1982.
>
> Ore Mining ... Six weeks are anticipated to signature by the Administrator, November 30, 1981. Substantive comments on the proposed rule are anticipated from industry and citizen action groups, but an extension to the comment period probably will not be necessary and no delay is anticipated in promulgating the final rule in July, 1982.

[7/] Attachment A, "Consent Decree Industry Summaries" (dtd. Oct. 23, 1981).

[8/] In seven of the high priority industries, EPA officials mentioned minor delays and possibilities that further delays could occur: Coal Mining, Metal Finishing, Foundries, Inorganic Chemicals, Iron and Steel, Porcelain Enameling, and Pulp and Paper.

> Organic Chemicals ... All the major technical and analytical work is complete. The BPT draft is written, BAT is near completion. Proposal by June 1982 is on schedule.
>
> Steam Electric ...The final rulemaking should be a 'minor' action, and the schedule of 6/82 for promulgation can be met.

In sum, close examination of this document reveals that many of the regulations technically were ready to proceed months ago, and that further delays would be caused only by continued footdragging at higher levels. For several of the regulations described immediately above, EPA now proposes inordinate delays -- 8 months for Ore Mining, 9 months for Organic Chemicals, and 9 months for Steam Electric. These additional delays suddenly appeared in the 4 month period between October 23, 1981 and March 5, 1982.

Defendants' justification for schedule delays, although somewhat obscured by their shifting posture, appears to divide into four broad categories: legal and policy reasons, alleged resource constraints, administrative procedures, and technical problems. We examine each in turn.

1. Legal and Policy Reasons.

Defendants advance two justifications for delaying regulations that arise outside the Act from purported legal and policy making obligations. These are: (1) their duty to incorporate the costs of ever changing regulations under RCRA;[9] and (2) their need to comply with the requirements of Executive Order 12291.[10]

Mr. Schatzow estimated that incorporating RCRA costs into these regulations could consume up to a year and a half, but that through administrative steps he had shortened that time to an average of 4 months. (Schatzow Aff. at 7-8). He emphasized, however, that the continuous changes in the RCRA regulations themselves would cause further delays. (Id. at 8). In EPA's Answers and Objections to Interrogatories (pp. 45-46), Defendants estimated that up to seven "man-months" would be required.

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[9] *See* Def. Mem. at 28; Schatzow Aff. at 4 -9; Answers and Objections to Interrogatories at 45-46.

[10] *See* Schatzow Aff. at 17; Supplemental Schatzow Aff. at 3-4; Errata to Supplemental Schatzow Aff.; Answers and Objections to Interrogatories at 24-30; Crampton Aff. at 5-6.

Plaintiffs strongly disagree with EPA's assertion that the Act even requires these additional burdens and delays. Congress established the Agency's requirements (and demanded that they be met promptly) long before these RCRA regulations were contemplated. And in defining the cost factors to be considered, Congress did not expect EPA to account for all extraneous circumstances.

The Court need not decide this issue, however, because there are ample reasons to end this Agency's fixation on its own, self-imposed moving target. There must be a time when EPA ends its fine tuning and updating of any clean water rule. These rules are several years overdue. They need not be made perfect, particularly when the perfection process itself is subject to continuous delays. As we noted above,[11] Judge Gesell moved to eliminate this dilemma in Illinois v. Gorsuch when he directed EPA to issue the best regulations under RCRA it was able to devise: "Congress did not direct the Agency to resolve every conceivable problem .... The Agency may fulfill its mandate ... as well as satisfy its lingering technical and policy concerns by issuing regulations and later consider revision if the Agency's understanding and expertise expand." 16 ERC at 2024.

That is the appropriate process to follow here. The Clean Water Act requires that each of these regulations be reviewed and revised, either annually or "from time to time" as the need arises. 33 U.S.C. §§ 1314(b), 1316(b)(1)(A), 1317(b)(2). EPA should issue regulations based on the latest available cost data, and revise those rules if later developments under RCRA materially alter its estimates. Accordingly, the Court should not sanction any further schedule delays on this basis.

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[11] See discussion at 10, supra.

The purported need to comply with Executive Order 12291 apparently has caused three kinds of resource burdens and further delays in EPA's proposed schedule. First, EPA has added 10 days for review by the Office of Management and Budget (OMB) of all "non-major" regulations. (Answers and Objections to Interrogatories at 30). Second, EPA has siphoned off resources to undertake additional analyses of "major" regulations: 0.5 work years and $50,000 to conduct water quality benefits analyses, and 0.75 work years and $70,000-$150,000 to conduct economic benefits analyses. (Id. at 28-29). Third, EPA has extended its schedules to allow OMB review of final, "major" regulations. EPA "assumes" that only two rules will be major (Crampton Aff. at 5), but cannot foreclose OMB from changing that assumption. Three weeks were added to the Iron and Steel schedule, and four weeks were added to the schedule for Organic Chemicals. (Answers and Objections to Interrogatories at 30). Defendants have not made clear what the combined effect will be of these three decisions.

These delays are precisely the kind of effects Defendants could avoid if they made a diligent effort to meet the Court's Order and exercised their available options. See Brown v. Neeb, 644 F.2d 551 (6th Cir. 1981). By its very terms, Executive Order 12291 exempts EPA's regulations: "The procedures prescribed by this Order shall not apply to: ...[a]ny regulation for which consideration or reconsideration under the terms of this Order would conflict with deadlines imposed by statute or by judicial order ...." E.O. 12291, Section 8(a)(2), 46 Fed. Reg. 13193, 13198 (Feb. 19, 1981).

EPA need not conduct these expensive and time consuming analyses -- particularly studies attempting to quantify economic and environmental benefits for which Congress deliberately chose not to require analyses under the Clean Water Act.[12] For these reasons, we urge the Court to require new schedules that, among other things, contain no delays for conducting studies or reviews under E.O. 12291.

2. Resource Constraints

EPA alleges two kinds of resource constraints on its ability to meet the Decree's requirements: (1) loss of budget funds, personnel and positions[13]; and (2) personnel shifts away from the Consent Decree program to other Agency responsibilities.[14] Despite Plaintiffs' attempts to discover the basis and timing of these alleged problems, neither has been clarified sufficiently to separate the effects of resource constraints from other kinds of difficulties in meeting the schedules. At least the following problems appear to have been alleged.

EPA claims that limitations on contract dollars, travel funds and personnel are the key resource constraints. (Schatzow Aff. at 9). Mr. Schatzow alleged that contracting funds decreased 26% in FY 1980, 10-15% in FY 1981, 48% in FY 1982, and at least another 10% in FY 1983 (Id.) Those percentages would result in the following dollar amounts for EPA contracting: 1979 ($20 million); 1980 ($14.8 million); 1981 ($13.3 million); 1982 ($6.9 million); and 1983 ($6.2

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[12] See generally Appalachian Power Co. v. EPA, No. 80-1663 (4th Cir., decided Feb. 8, 1982); EPA v. National Crushed Stone Ass'n, 449 U.S. 64 (1980).

[13] See Def. Mem., at 29; Schatzow Aff. at 9; Supplemental Schatzow Aff. at 1-2.

[14] See Schatzow Aff. at 12; Answers and Objections to Interrogatories, at 12-15.

million). Later Mr, Schatzow changed his estimates to show a significant increase in 1980 (36.8%) and no change for 1981.[15] These new percentages would result in $27.4 million for 1980 and 1981; $14.3 million for 1982; and $12.8 million for 1983. Even though these new estimates are roughly double the original estimates, EPA's schedule nevertheless has become longer. Accordingly, EPA has reversed its earlier allegation that funding constraints are a "major factor affecting the schedules proposed by EPA." (Supplemental Schatzow Aff. at 2).

In any event, Defendants' resource arguments are insufficient to sustain EPA's amended motion for schedule delays. They fail for two reasons. First, although the Court denied Plaintiffs' discovery requests for FY 1983 budget documents, we offer evidence that Defendants "manufactured" their changed circumstances; EPA first decided on its schedule delays, and then cut its own budget. Second, EPA's budget (and particularly its internal allocation of resources) lies largely within the Agency's ability to control. Defendants have not been faced with an impossibility. With proper diligence and a commitment to complying with the Court's order, EPA either could have insisted on greater resources, as past Administrations have, or reallocated other resources from programs that are neither long overdue nor governed by court orders.

In October 1981, Plaintiffs obtained three documents showing that EPA's alleged resource constraints were neither "unforseen" nor beyond the Agency's ability to affect. One is the Agency's FY 1982 budget submission to the House Committee on Appropriations. In a (now published) hearing before the Committee on April 1, 1981, the Acting EPA Administrator proposed drastic cuts for the Effluent Guidelines program

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[15] Mr. Schatzow also revised downward (from 7 to 5) his estimate of technical project officers who had left his division (Supplemental Schatzow Aff. at 2).

(from $30 million and 112 positions in FY 1981, to $16 million and 85 positions in FY 1982).[16] The Administrator's written justification was that "[t]his decrease reflects a *policy decision* to promulgate Effluent Standards and Guidelines over a longer time-frame ...."[17] . EPA apparently made this decision in early 1981, sought reduced funding, and then in August petitioned this Court to grant relief based on "unforseen circumstances."[18]

The second document reveals EPA's overall strategy to abandon this court-ordered program altogether. It is EPA's FY 1983 Decision Unit Analysis for the Research and Development Program. [19] In it, EPA emphasizes that the R&D Program's goal is to:

> address ambient water quality problems on a local or regional basis from a cost-effectiveness/cost and risk-benefit perspective. *This will allow a departure from* use of uniform *national water quality goals* and *best available technology as the basis for establishing pollution control requirements* for each discharger.

This new goal apparently originated from a policy shift that occurred in the water program office. The third document is a July 17, 1981 budget request from the Acting Assistant Administrator for Research and Development, Dr. Andrew P. Jovanovich, to the Administrator.[20] Dr. Jovanovich explained that his request had been "critically reviewed ... for inconsistency with [the Administrator's] budget guidance."

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[16] Attachment B, portions of: "Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives," 97th Cong., 1st Sess. (1981).

[17] *Id.*, at 379, 386 (attached).

[18] Plaintiffs' inability to discover EPA's FY 1983 budget documents for this program prevents us from showing the Court that the same strategy was pursued in the FY 1983 budget.

[19] Attachment C, portions of: U.S. EPA, "Decision Unit Analysis, DU CODE B107 (September 11, 1981). This document was not the subject of any of Plaintiffs' discovery requests.

[20] Attachment D. This document was not the subject of any of Plaintiffs' discovery requests.

He then revealed that, as a policy matter, the Consent Decree controls are being abandoned:

> The focus of the base water quality research program is on facilitating the program office's policy shift of controlling of pollution sources on the basis of potential benefits to improving water quality as opposed to point source control using best available technology. Much of the research will be aimed at giving the States the tools to make this shift.

This memorandum was submitted to the Administrator two weeks prior to EPA's August motion to modify the Decree.

These documents make clear that EPA not only has the ability to manipulate its resources toward or away from the Court's order, but has done so. We believe they show, at a minimum, that resource constraints were neither unforseen nor outside of EPA's control. In addition, we believe they are evidence of a policy shift that led EPA to "manufacture" its own changed circumstances. In either event, they demonstrate that EPA's resource-constraint excuse cannot prevail.

Likewise, EPA's shift of Consent Decree personnel to other work required by RCRA is not an "unforseen" or uncontrollable circumstance. The Agency decided to make these shifts with full knowledge and disregard of their resulting effects on the Court's order.

Defendants' Answers to Interrogatories (pp. 12-15) demonstrate that enormous personnel resources have been drained from the Consent Decree program. In FY 1981, the equivalent of eight people out of about 50 were assigned to RCRA work.[21] In 1982 and 1983, the figures were 6 out of 40, and 4.5 out of 32 respectively.[22] Of this three-year total (18.5 person years), 5.65 years (over 30 percent) were drained away from work on the Organic Chemicals regulation. It is no wonder that EPA's schedule for this regulation has slipped more than any other industry under the Decree.

Plaintiffs foresaw these potential delays and, knowing that EPA could freely reassign personnel to meet its obligations, wrote to the Administrator on February 25, 1980 urging him not to siphon resources away from these court-ordered duties. The Administrator responded on April 22, 1980.[23] In his letter, the Defendant stated that personnel shifts to RCRA work had been minor and had not theretofore contributed significantly to delays in the Consent Decree program. Moreover, he did not think these shifts would continue or seriously affect the timeliness of Consent Decree regulations. Since "most of the basic technical and economic studies [were] complete," he anticipated publishing the remaining regulations over the next several months. That was nearly two years ago.

The "changed circumstances" EPA now pleads clearly were manufactured. They are not imaginary, but they were created by Defendants even though other options were available. EPA has hardly "marshalled its resources" to comply with the Consent Decree, and should not be permitted to proceed in any fashion it chooses while ignoring this Court's order.

21/ Comparison of estimates provided in Defendants' Answers to Interragotires at 13, with totals of data furnished in Schatzow Aff. at 11.

22/ *Id.*

23/ Attachment E, letter dtd. April 22, 1980 from EPA Administrator Douglas M. Costle to J. Taylor Banks.

3. Administrative Procedures.

EPA advances three additional reasons for delaying these rules that are related to Agency administrative procedures.[24/] First, Defendants ask the Court's continued indulgence to permit the new administration to conduct an unprecedented and more thorough review of these rules.[25/] Second, EPA has padded its new schedules to allow time for resolving any "unexpected issues that may arise."[26/] Third, the new proposed schedules contain additional delays to "avoid clustering" that might produce "bottlenecks" in the rulemaking process.[27/]

EPA has provided 3 to 5 months in each schedule for its new "expedited" Agency review procedures.[28] Despite the short-cuts described in Defendants March 5 motion papers, this review period is still longer than EPA has needed in the past. Mr. Costle's April 22, 1980 letter to Plaintiffs demonstrates that Defendants can do much better without jeopardizing these rules.[29/] In describing actual reviews of six regulations, Mr. Costle said: "the internal Agency review process itself has not contributed to the program delays .... Overall, the three to three and one-half month review ensures that the Agency will produce a well-considered regulation which will be able to withstand scrutiny after promulgation."

[24/] A fourth, extension of public comment periods, has been retracted in the Agency's most recent filings. See Crampton Aff. at 6.

[25/] Supplemental Schatzow Aff. at 3; Crampton Aff. at 10.

[26/] Crampton Aff. at 10, par. 16.

[27/] Id. par. 15(D).

[28/] Id. at 8, par. 15(A)(ii).

[29/] Attachment E.

Under the new procedures described by Mr. Crampton, the new administration should be able to shorten, not lengthen this period. In setting deadlines, Congress and this Court did not afford Defendants the time for leisurely reviews. Indeed, for pretreatment standards required by the Decree, Congress required that rules be promulgated 90 days after the proposal (33 U.S.C. § 1317(b)(1)), and for new-source standards of performance the total period is 120 days. 33 U.S.C. § 1316(b)(1)(B). As the court observed in Mayberry v. Maroney, 558 F.2d 1159 (3d Cir. 1977), these obligations cannot be changed merely for Defendants' convenience, or to accommodate a change of heart based on hindsight.[30/]

Similarly, potential bottlenecks and future unknown issues are not legitimate excuses to extend these schedules. The Administrator can anticipate any bottlenecks, and either avoid them through managing the Agency's resources more effectively, or expedite some of the rules to prevent clustering. And as Judge Gesell required in Illinois v. Gorsuch,[31/] EPA can resolve future issues -- after proposing or promulgating these rules -- under its authority to consider revisions.

4. Technical Problems.

Plaintiffs have always been willing to accommodate adjustments in EPA's schedules due to legitimate technical problems that have arisen. These are precisely the kinds of "unforseen circumstances," beyond a defendant's control despite diligent efforts, for which relief under Rule 60(b) is appropriate. Plaintiffs' agreement to the 1979 modifications of the Consent Decree was premised largely on these kinds of difficulties.

[30/] See discussion at 9, supra.

[31/] See discussion at 10, supra.

Here, EPA alleges numerous technical problems in support of its motion: inadequate performance by the Agency's contractors,[32] problems with statistical methods,[33] data problems,[34] and difficulties with analytical methods.[35] Plaintiffs do not object to extensions based on these legitimate changes in circumstances, provided they can be separated from other alleged, but inadequate excuses described above. In particular, if these problems can be overcome with additional or reallocated resources, Defendants must make diligent efforts and take all steps within their authority to do so.

B. Deletion of Programs and Industrial Regulations.

Defendants have not advanced any legitimate reasons for deleting various programs and categorical regulations from the Decree. In effect, they are saying "we do not wish to meet these obligations." In fact, however, their reasons apparently are to please the industry intervenors in this litigation.

On June 4, 1981, EPA's General Counsel and the Acting Administrator for Water sent a memorandum to Administrator Gorsuch recommending that EPA seek a "stretched-out" schedule, deletion of some categorical regulations, and elimination of the Decree's remaining programs.[36] The memorandum attached letters and briefing papers that had been furnished to the Acting Administrator, the Secretary of Commerce and the Vice President's office by chemical and steel company intervenors in this case (attached).

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[32] Schatzow Aff. at 15.

[33] Crampton Aff. at 9, par. 15(B)(i).

[34] Id., par. 15(B)(ii).

[35] Id., par. 15(B)(iii).

[36] Attachment F, Memorandum dtd. June 4, 1981.

The memorandum recommended that EPA adopt precisely the modifications urged in Intervenors' March 17, 1981 motion to modify. Since "the decision as to how to modify or vacate the decree [was] secondary to whether to do so," EPA left the drafting to the chemical companies.[37] (emphasis in the original). This option was recommended because "[i]t would also make us less vulnerable to an action to enforce the decree."[38] The memorandum concluded: "while industry would prefer Option A [vacate the Decree], we anticipate that they would be pleased with the choice of Option B [motion to modify]. Obviously, the choice of either Option A or B would not please the environmentalists."[39]

In sum, EPA is before this Court because it wants freedom from the Decree to implement the "policy shift" described above,[40] not because it needs that freedom. The reasons actually offered the Court do not justify Defendants' motion.

1. Program Deletions

EPA moves to delete six important provisions from the Decree: (1) the obligation to identify sources that discharge pollutants listed in Appendix C (par. 4(b)); (2) the responsibility to identify and control discharges of toxic pollutants not listed in the Consent Decree (par. 4(c)); (3) the duty to regulate at least a minimum percentage of sources in each industrial category (par. 6); (4) the need to publish complete ambient criteria for each of the Decree's listed toxic pollutants (par. 11); (5) the duty to clean up pollutants and water bodies for which the Decree's categorical regulations will be inadequate to protect public health (par. 12); and

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[37] Id. at 3, fn. 3.

[38] Id. at 5.

[39] Id.

[40] See discussion at 19, supra.

(6) the requirement to promulgate certain specific pretreatment standards (par. 13).[41]

EPA's primary reason for these sweeping requests is that it "should no longer be required to take actions which, in the absence of the decree, would lie within the Agency's discretion. ..."[42] Because of alleged resource constraints and collateral obligations, many of which we addressed above,[43] Defendants seek the freedom to re-evaluate their priorities. In particular, EPA hopes to use Executive Order 12291 to decide whether it should undertake these programs at all, and wishes to avoid any legal challenge should it choose to drop them.[44]

The Court already has decided that it is not compelled to delete obligations that are more specific than mandated by the Act. NRDC v. Gorsuch, 16 ERC 2085 (D.D.C. 1982). In its opinion, the Court noted that EPA "can petition the court to modify the decree if circumstances change, and if convincing, can have the court effect the desired modification ...." Id. at 2089. EPA must carry the heavy burden of showing that circumstances, not merely preferences, have changed. Mayberry v. Maroney, 558 F.2d 1159 (3d Cir. 1977).

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[41] Def. Mem. at 32, fn. 24. In addition, EPA requests several modifications that are neither explained in its papers nor apparent from the proposed order submitted on March 5, 1982. These changes are shown on the Intervenors' motion papers filed March 17, 1981, a copy of which is included with Attachment F. Among other things, EPA proposes to: (1) eliminate the need for dischargers to comply "at the earliest possible time" prior to July 1, 1984; (2) eliminate all of the Decree's detailed constraints on EPA's exclusions under Paragraph 8; and (3) eliminate EPA's duty to reopen permits and incorporate regulations promulgated under the Decree.

None of these modifications has been justified by EPA. For the reasons outlined below, we respectfully urge the Court to reject each of these requests.

[42] Id. at 26.

[43] Our earlier examination of EPA's alleged burdens applies here as well, and will not be repeated. See discusson at 16-20, supra.

[44] Id. at 31.

As we noted earlier, the Court must consider whether the requested modifications will serve the purposes of the Decree and the Act. There is no doubt that deleting these program requirements will thwart the Decree's purposes -- to require a timely, comprehensive and interrelated toxics control program. Indeed, EPA's obligations under paragraphs 4(b), 4(c), 11, 12 and 13 relate closely to the principal reasons Plaintiffs commenced this litigation nearly 10 years ago.

Moreover, Congress' purposes are best served by maintaining each of these obligations. The Court noted in its 1979 opinion that since had Congress endorsed the Decree, but codified only portions of it, one could infer that "Congress intended for the Agreement to remain in effect to supply the missing details of a cohesive strategy for controlling toxic water pollution." NRDC v. Costle, 12 ERC 1833, 1836 (D.D.C. 1979). The requirements EPA proposes to delete are those very details. Defendants simply are wrong in their argument that Congress intended to leave them discretion and flexibility to ignore these obligations. Id. at 1834-46.

These requirements also constitute the program elements for which Plaintiffs bargained, and for which we relinquished our causes of action. EPA's new-born quest for more management flexibility is not sufficient to undermine that bargain. Mayberry v. Maroney, 558 F.2d 1159, 1164 (3d Cir. 1977). If Defendants now truly need additional resources and flexibility to meet their Agency-wide obligations, their recourse is to Congress, not the Court.

Defendants also have not shown that these requirements impose the extreme degree of hardship needed to gain the requested relief. The Decree clearly has not become an "instrument of wrong." For example, EPA estimates that only 1.8 work years and $150,000 will be needed to complete its tasks under paragraph 4(c),[45] and that 0.5 work years and no no contract funds will be needed to comply with paragraph 12.[46] The combination of these resources is less than EPA has drained away from the Consent Decree for RCRA activities.[47]

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[45] EPA also admits that it has not requested these resources from OMB for any year following FY 1979. See Answers and Objections to Interrogatories at 42.

Finally, the harm to which these requirements are directed has not been "attenuated to a shadow." Except for partial actions under paragraphs 11 and 13, EPA has not taken steps to meet the toxics dangers addressed by these provisions.[48] The Decree's comprehensive, integrated toxics program will be undercut severely if EPA fails to meet these obligations.

2. Deletion of Industrial Regulations

Defendants propose two reasons for deleting industrial, categorical regulations from the Court's order. The first set of deletions would be for those industries EPA plans to "exclude" under the criteria and procedures of paragraph 8 of the Decree.[49] We urge the Court to reject this request out of hand, since the deletions are premature and easily addressed under the existing Decree. EPA has suffered no hardship whatsoever, and certainly the procedures of paragraph 8 impose no "grievous wrong" on the Defendants.

The second set consists of categories and subcategories for which EPA has not even attempted to develop a justification under paragraph 8. Specifically, EPA asks that the following categories and subcategories simply be dropped: Adhesive and Sealants, Plastics Processing, Can Making, and portions of Inorganic Chemicals and Nonferrous Metals.[50] Hundreds of specific subcategories and no doubt thousands of dischargers would be dropped from the program.[51] Where EPA has conducted sampling, the data show that many of the Decree's toxic pollutants are present in discharges from these plants.[52]

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[46] Answers and Objections to Interrogatories at 42-43.

[47] See discussion at 20, supra.

[48] EPA claims to have met some of its obligations under paragraph 12. See Answers and Objections to Interrogatories at 42-43. While the validity of this claim is not before the Court at present, Plaintiffs nevertheless note their strong objection to EPA's assertion. We believe Defendants have failed to accomplish any of the paragraph 12 requirements. See Attachment G, letter from Plaintiffs to EPA Administrator Anne Gorsuch, dtd. Mar. 15, 1982.

[49] Schatzow Aff. at 16.

EPA's justification is that the job of addressing these industries is difficult. Sampling problems have occurred, resources are scarce, and EPA believes it would be "unwise" to begin developing some of these regulations.[53]

These are not legitimate reasons to ignore the toxics problems caused by these industries. The purposes of the Court's order would not be advanced, since the harm Plaintiffs intended to address apparently still exists. If it does not, EPA can develop and document its views under the requirements of paragraph 8.

Moreover, EPA has not acted diligently to pursue these obligations. Instead, Defendants have manufactured the problems they now urge on the Court. In 1979, Plaintiffs met with EPA and twice wrote to the official in charge of this program.[54] We repeatedly stressed that EPA must move forward -- even if only on extended schedules -- to develop these regulations, because their excuses did not fit the paragraph 8 criteria. Defendants did not move to comply, and instead stopped assigning personnel and resources to this work.

Defendants are asking the Court to approve actions they took long ago without any legitimate justification or even a prior request to the Court. They have manufactured not only the reasons but the result. Plaintiffs urge the Court to reject both, and to sustain the bargain to which Defendants voluntarily agreed.

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[50] Schatzow Aff. at 16-17.

[51] Schatzow Aff., Attachment thereto.

[52] *See* Answers and Objections to Interrogatories at 32-39, and Attachment C thereto.

[53] Schatzow Aff. at 16-17.

[54] Attachment H, letters to Swep T. Davis dtd. June 22, 1979 and August 3, 1979.

CONCLUSONS AND RECOMMENDATIONS

For the foregoing reasons, Plaintiffs respectfully urge the Court to deny EPA's amended motion to modify the Consent Decree. The Court should retain each of the provisions EPA wishes to delete or amend, and decline to extend the Agency's schedules in accordance with Defendants' motion.

The Court should not stop there, however, for many of the deadlines in the current Decree have passed and cannot be enforced. Consequently, Plaintiffs recommend that the Court require EPA to promptly submit new proposed schedules for paragraph 7 that are strictly limited according to specific conditions and outside deadlines. The criteria would enumerate those processes and factors that no longer can be used to form the basis of Defendants' schedules. A proposed order implementing Plaintiffs' recommendation is attached to this memorandum.

Finally, Plaintiffs respectfully urge the Court to stay its hand briefly regarding Defendants' obligations under paragraph 12 of the Decree. As indicated in Attachment G to this memorandum, Plaintiffs will be discussing this matter with Defendants, and hope to resolve our differences before involving the Court.

Respectfully submitted,

J Taylor Banks

J. Taylor Banks
Attorney for Plaintiffs
Natural Resources Defense Council
1725 I Street, N.W., Suite 600
Washington, DC 20006
(202) 223-8210

Dated: March 29, 1982

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

NATURAL RESOURCES DEFENSE COUNCIL, INC.
et al.,

Plaintiffs,

v.

ANNE M. GORSUCH, Administrator
Environmental Protection Agency, et al.

Defendants

and

UNION CARBIDE CORP., et al.,

Intervenors.

Civil Action Nos.
2153-73
75-0172
75-1698
75-1267

ORDER

This matter is before the Court on Defendants' amended Cross-Motion to Modify the Consent Decree in these consolidated cases. Upon consideration of Defendants' motion and supporting affidavits and Plaintiffs' response thereto, and the Court having heard oral argument of counsel, it is, by the court this ____ day of ________________, 1982

ORDERED that the Cross-Motion to Modify the Consent Decree, as amended, be and hereby is, denied; and it is further

ORDERED that on or before ___________________, 1982, Defendants shall file with the Court and serve on all counsel a schedule of suggested dates for proposing and promulgating each set of regulations listed under Section D. 6(b) of Defendants' March 5, 1982 proposed order; and it is further

ORDERED that Defendants' schedule shall conform to the following restrictions:

1. All regulations previously proposed by Defendants shall be promulgated as expeditiously as possible, but no later than 180 days from the date of this order,

2. All regulations not previously proposed by Defendants shall be proposed as expeditiously as possible, but no later than 180 days from the date of this order, and shall be promulgated as expeditiously as possible thereafter, but no later than 180 days following proposal,

3. In developing the most expeditious schedule possible within these restrictions, Defendants shall conform their actions to the following conditions:

(a) The schedule shall contain no additional material delays for considering changes in cost data due to changes in regulations under the Resource Conservation and Recovery Act.

(b) The schedule shall contain no time (beyond that required for Agency reviews, as prescribed by condition (d), below) for reviews of any proposals or promulgations of regulations by the Office of Management and Budget under Executive Order 12291, or any delays to prepare impact assessments pursuant to E.O. 12291.

(c) The schedule shall reflect all possible internal and external Agency actions, under Defendants' authority to accomplish or request, for minimizing or eliminating any material effects on the suggested dates caused by resource constraints (both funding and personnel). Defendants shall submit with their suggested schedule a report to the Court describing any such constraints as well as Defendants' actions and requests to remove those constraints.

(d) The schedule shall include no more than 90 days for formal Agency review of each regulatory action, including Steering Committee review, Red Border review, and review by the Administrator.

(e) The schedule shall include no additional time to resolve presently unanticipated issues or problems, or to avoid clustering regulatory actions.

(f) The schedule shall reflect Defendants' best efforts to resolve all outstanding technical and methodological problems that might materially delay the suggested dates otherwise developed pursuant to conditions (a) through (e); and it is further

ORDERED that for each set of regulations described in paragraphs 31 through 33 of the July 31, 1981 Affidavit of Steven Schatzow (except those regulations excluded pursuant to paragraph 8 of the Decree prior to the date of this Order), Defendants shall file with the Court and serve on all counsel, on or before __________________, 1982, either: (1) an affidavit justifying an exclusion under paragraph 8 of the Decree; or (2) a suggested schedule for proposing and promulgating the regulation as expeditiously as possible. In developing the most expeditious schedules possible, Defendants shall conform their actions to conditions (a) through (f) prescribed in this order.

____

UNITED STATES DISTRICT JUDGE

CERTIFICATE OF SERVICE

I hereby certify that the foregoing Plaintiffs' Memorandum In Opposition to Defendants' Cross-Motion To Modify Consent Decree was served this day by hand delivering to the following persons:

Barry Neuman
Land and Natural Resources Division
U.S. Department of Justice
10th & Constitution Ave., NW
Washington, DC 20530

Susan Lepow
Assistant General Counsel for Effluent Guidelines
Environmental Protection Agency
401 M Steeet, Room 503 West
Washington, DC 20460

Richard E. Schwartz
Thomas L. Anderson
Collier, Shannon, Rill & Scott
1055 Thomas Jefferson St., NW
Washington, DC 20007

Douglas E. Kliever
Charles F. Lettow
Mary Wild Ennis
Cleary, Gottlieb, Stein & Hamilton
1250 Connecticut Avenue, NW
Washington, DC 20036

Robert F. Stauffer,
General Counsel
National Coal Association
1130 17th Street, NW
Washington, DC 20530

Roberts R. Owen
Theodore L. Garrett
Covington & Burling
888 16th Street, NW
Washington, DC 2 20006

Michael Barr
George C. Freeman, Jr.
Hunton & Williams
1919 Pennsylvania Avenue, NW
Washington, DC 20006

Douglas E. McAllister
1920 N Street, N.W.
Washington, DC 20036

David E. Lindgren
Arnold S. Block
2101 L Street, NW
Washington, DC 20037

Michael K. Glenn
Chadbourne, Parke, Whiteside & Wolfe
1612 K Street, NW
Washington, DC 20006

J Taylor Banks
J. Taylor Banks

March 29, 1982

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

FILED
MAY - 7 1982
JAMES F. DAVEY, Clerk

NATURAL RESOURCES DEFENSE COUNCIL, et al.,

Plaintiffs,

v.

ANNE M. GORSUCH, Administrator, Environmental Protection Agency, et al.,

Defendants.

and

UNION CARBIDE CORP., et al.,

Intervenors.

Civil Action Nos.
2153-73
75-0172
75-1267
75-1698

ORDER

This matter is before the court on Defendants' amended Cross-Motion to Modify the Consent Decree in these consolidated cases. Upon consideration of Defendants' motion and supporting affidavits and Plaintiffs' response thereto, and the Court having heard oral argument of all counsel, the court finds that at the present time the defendants have presented insufficient justification for revising the consent decree in these cases. While recognizing that the defendant agency has in fact been working under the decree since its inception, the court believes that at this point in time the EPA must be pushed to work harder. On this point, the court finds it noteworthy that the statutory compliance date for the industries affected by EPA's regulations in this area is July 1, 1984, a date which is rapidly approaching. A further consideration behind the court's decision is the fact that paragraph 8(a)(4) of the consent decree already provides a procedure whereby EPA can move to effect some of the modifications presently urged upon the court.

In making this decision, the court recognizes the need to retain flexibility in the supervision and implementation of this decree. However, at this time, the requested flexibility appears unwarranted. At this time, the court hopes that this Order will "serve like adrenalin, to heighten the response and to stimulate the fullest use of resources" at EPA; if this results in overstimulation of the agency or if other compelling circumstances indicate the need for palliative measures at some later date, then such measures can be taken by the court at that time. See Natural Resources Defense Council v. Train, 610 F.2d 697, 712 (D.C. Cir. 1975). As a result, it is, by the court, this 7th day of May, 1982,

ORDERED that the Cross-Motion to Modify the Consent Decree, as amended, be and hereby is, denied; and it is further

ORDERED that on or before June 21, 1982, 1982, defendants shall file with the court and serve on all counsel a schedule of suggested dates for proposing and promulgating each of the following sets of regulations: Aluminum Forming; Battery Manufacturing; Coal Mining; Coil Coating; Copper Forming; Electric & Electronic Components; Foundries; Ink; Inorganic Chemicals (Phase 1); Iron & Steel; Leather Tanning & Finishing; Metal Finishing; Nonferrous Metals (Phase 1); Ore Mining; Organic Chemicals and Plastics & Synthetic Materials; Paint; Pesticides; Petroleum Refining; Pharmaceuticals; Porcelain Enameling; Pulp & Paper; Steam Electric; Textile Mills; and Timber; 1/ and it is further

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1/ From section D.6(b) of the defendants' proposed order on this motion, it appears that this Timber regulation has already been promulgated; if this is true, then, of course, defendant need not propose a schedule for its promulgation. Because it was included in the defendants' proposed order, this court has, out of an abundance of caution, decided to include it in this order.

ORDERED that defendants' schedule shall conform to the following restrictions:

1. All regulations previously proposed by defendants shall be promulgated as expeditiously as possible, but no later than 180 days from the date of this order, [2/]

2. All regulations not previously proposed by defendants shall be proposed as expeditiously as possible, but no later than 180 days from the date of this order, and shall be promulgated as expeditiously as possible thereafter, but no later than 180 days following proposal,

3. In developing the most expeditious schedule possible within these restrictions, defendants shall conform their actions to the following conditions:

(a) The schedule shall contain no additional material delays for considering changes in cost data due to changes in regulations under the Resource Conservation and Recovery Act.

(b) The schedule shall contain no time (beyond that required by Agency reviews, as prescribed by condition (d), below) for reviews of any proposals or promulgations of regulations by the Office of Management and Budget under Executive Order 12291, or any delays to prepare impact assessments pursuant to E.O. 12291. [3/]

2/ This will only force the EPA to promulgate three of the thirteen currently proposed regulations in a shorter time period than the agency itself had requested. See Defendant's Proposed Order at Section D.6(b) (requested schedule for regulation proposal and promulgation).

3/ The regulations at issue in this case appear, in any event, to be exempted from the strictures of Executive Order 12291. See Executive Order 12291, Section 8(a)(2), 46 Fed. Reg. 13193, 13198 (Feb. 19, 1981) (E.O. 12291 procedures inapplicable if application of same would conflict with statutory or judicial deadlines).

(c) The schedule shall reflect all possible internal and external agency actions, under defendants' authority to accomplish or request, for minimizing or eliminating any material effects on the suggested dates caused by resource constraints (both funding and personnel). Defendants shall submit with their suggested schedule a report to the court describing any such constraints as well as defendants' actions and requests to remove those constraints.

(d) The schedule shall include no more than 90 days for formal agency review of each regulatory action, including Steering Committee review, Red Border review, and review by the Administrator.

(e) The schedule shall include no additional time to resolve presently unanticipated issues or problems, or to avoid clustering regulatory actions.

(f) The schedule shall reflect defendants' best efforts to resolve all outstanding technical and methodological problems that might materially delay the suggested dates otherwise developed pursuant to conditions (a) through (e); and it is further

ORDERED that for each set of regulations described in paragraphs 31 through 33 of the July 31, 1981 Affidavit of Steven Schatzow (except those regulations excluded pursuant to paragraph 8 of the Decree prior to the date of this Order), defendants shall file with the court and serve on all counsel, on or before June 21, 1982, 1982; either: (1) an affidavit justifying an exclusion under paragraph 8 of the Decree; or (2) a suggested schedule for proposing and promulgating the regulation as expeditiously as possible. In developing the most expeditious schedules possible, defendants shall conform their actions to conditions (a) through (f) prescribed in paragraph 3 of this Order.

Thomas A Flannery
UNITED STATES DISTRICT JUDGE

Natural Resources Defense Council, Inc.

1725 I STREET, N.W.
SUITE 600
WASHINGTON, D.C. 20006
202 223-8210

New York Office
122 EAST 42ND STREET
NEW YORK, N.Y. 10168
212 949-0049

Western Office
25 KEARNY STREET
SAN FRANCISCO, CALIF. 94108
415 421-6561

March 15, 1982

Ms. Anne Gorsuch, Administrator
U.S. Environmental Protection Agency
Room 1200 West Tower
401 M Street, S.W.
Washington, D.C. 20460

Dear Ms. Gorsuch:

We are writing to advise you that EPA stands in direct violation of the Consent Decree and the U.S. District Court's order in NRDC v. Gorsuch.*/ Paragraph 12 of the Decree requires that you identify contaminated water bodies and toxic pollutants of broad geographical concern, and publish strategies that address those problems. These obligations have not been met, and recent statements by you and your staff indicate that they will not be met in the near future.

As you know, for nearly a decade NRDC has been deeply concerned about EPA's efforts to curtail toxic discharges. We commenced this litigation in 1973 in part because the Agency had failed to regulate specific toxic pollutants, as required by the 1972 Clean Water Act. The 1976 settlement agreement substituted EPA's preferred, categorical approach for the Act's mandate to target individual chemicals. But Paragraphs 11 and 12 were inserted in the Decree to provide a "specific and substantial" back-up program for identifying and addressing problems left unsolved by the categorical approach.

Over the past six years, NRDC has shown patience and a willingness to accomodate any of EPA's legitimate problems with data and analytical methods. We have acquiesced in extensive delays under Paragraphs 4, 7, 11 and 12 despite our concern that this program be carried out as expeditiously as possible. And we have agreed to provide EPA considerable additional flexibility under Paragraph 8. In short, we have been able to work out our differences in this litigation because EPA has demonstrated its willingness to use best efforts in meeting the Decree's requirements.

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*/ 8 ERC 2120 (D.D.C. 1976), as modified, 12 ERC 1833 (D.D.C. 1979).

But EPA's Paragraph 12 "identifications" and its so-called strategy of February 3, 1982 constitute serious departures from the Agency's previous efforts to resolve this important, national problem. Indeed, they indicate an intent to abandon the program established by Paragraph 12 of the Decree. NRDC will not allow this program to go down the drain.

We sincerely hope it will be possible to agree on remedial measures that will cure the problems outlined below. Accordingly, we request that you meet with us immediately to discuss this matter. If we cannot reach an understanding on EPA's future conduct, NRDC will have no choice but to commence a contempt action against you in the U.S. District Court for the District of Columbia.

* * *

Paragraph 12 was included in the Decree so that EPA would target, and then systemmatically address, toxic pollution hot spots and chemicals. Subparagraph (a) requires that you forthwith establish controls to deal with specific pollution sources whenever it is determined that the standards and limitations otherwise required by the Decree are inadequate. The remainder of Paragraph 12 establishes the program requirements and deadlines for making those determinations, and for developing the strategies to implement such controls.

In short, the specific program requirements of Paragraph 12 are designed to accomplish two things: (1) they will enable you to make these important determinations about hot spots and pollutants; and (2) they will inform the public what your resulting actions will be, and when you intend to carry them out. As discussed below, the Agency has accomplished neither of these objectives, and consequently is not in a position to establish the more-stringent controls contemplated by Subparagraph 12(a).

1. Toxic Hot Spot Identifications

By July 1, 1981, you were to have identified "those portions [of the navigable waters] that are seriously contaminated by discharges of toxic pollutants ... as well as the presence and amounts of specific pollutants and their sources that are causing such contamination ...." (Pars. 12(b)(i) and 12(c)) (emphasis added). This language contains three specific requirements: that you identify (1) polluted water bodies, (2) the pollutants in them, and (3) the sources of those pollutants. The Agency's own admissions and disavowals demonstrate that none of these has been accomplished.

On July 27, 1981, EPA released to NRDC a document titled "Lists of Areas and Pollutants for Which Toxic Water Pollution Controls May be Necessary to Protect Aquatic Life and Human Health in Compliance with ¶ 12 of the Consent Decree ...." The document purported to be issued "in accordance with the July 1 deadline in the Decree," and among other things listed streams in 34 metropolitan areas "where additional controls may be necessary." According to EPA's document, the selection of these areas was based on "dilution studies" as well as "a thorough review" of water quality data and other available information. Moreover, the document promised that "additional water quality monitoring study programs" would be undertaken for each of these areas.

Nevertheless, you and your staff repeatedly and emphatically have denied that the July 27, 1981 list and supporting documents meet any of the Paragraph 12 requirements. Indeed, EPA's work under Paragraph 12 has been thoroughly repudiated.

For example, in letters to the mayors of each metropolitan area you stressed the many caveats and qualifications EPA placed on these studies, and characterized those studies as "a very rough analysis ... based on theoretical calculations." Among other things, you flatly denied the accuracy of the July 27 document's characterization of these waters as "most polluted." And in reference to NRDC's description (in a press release) of these waters as "seriously contaminated," you stated that "these press accounts do not accurately reflect EPA's position with respect to those cities."

Then in a September 28, 1981 letter to me, Mr. Bruce Barrett, Acting EPA Assistant Administrator for Water, emphasized that the identifications and EPA's technical support documents fall far short of your Paragraph 12 obligations. Mr. Barrett stated:

> They [EPA's "Action Recommendations" for each hot spot] include a brief description of ambient stream data, a cursory discussion of a dilution study, and a very preliminary 'pencil and paper' analysis of possible toxic pollutant levels at drinking water plant intakes.
>
> These Action Recommendations have not been publicized by EPA since they are based upon many assumptions, including several critical assumptions now known to be incorrect.
>
> . . .
>
> As is apparent, these EPA documents are very preliminary analyses designed for use in future field studies to see if toxic problems exist in the areas identified.

(emphasis added). In short, Mr. Barrett denied that EPA has identified any seriously contaminated water bodies, and indicated that only through future studies could such identifications be made. The five-page summary attached to Mr. Barrett's letter confirms repeatedly that EPA has not completed this work.

Moreover, in numerous statements to the press, Agency officials have stressed that EPA's identifications are faulty -- perhaps meaningless. In a statement to the *Washington Post*, for example, Mr. Byron Nelson said "the numbers were just calculations and didn't involve any monitoring. We really don't know what's in there." Mr. Steven Schatzow, EPA's Director of the Office of Water Regulations and Standards, said the "list was caveated to death. It was a table-top analysis, highly preliminary, based on very little actual data collection." And Dr. Tim Stuart, Chief of the Monitoring Branch, was reported in *The Oregonian* to have stated that the list was based on reports that were the result of "guesswork." "We're not saying ... that anything is polluted," he said. "We suspect it might be, but we just don't know."

It is patently obvious from these statements that EPA has not met its three obligations under Paragraph 12. It has not identified "those portions [of the navigable waters] that are seriously contaminated by discharges of toxic pollutants."

As Mr. Nelson admitted, it has no knowledge of the presence or amounts of pollutants in those waters. And EPA hasn't a clue which sources are causing toxic contamination -- or, in numerous instances, even which sources are still discharging. These violations of the Decree must be remedied first, since EPA cannot meet its other obligations until the necessary identifications have been made.

Finally, it is equally obvious that on-going and planned monitoring studies have not, and will not, remedy these violations within (or even close to) the Decree's timetable. At a briefing (required by Paragraph 9 of the Decree) on March 8, 1982, I asked your staff for further information about these studies. Mr. Stuart said he thought that only 16 such studies were planned or perhaps underway by the states, but could not provide any details. He suggested that I contact state officials, but neither he nor Messrs. Leutner or McBride could even name which states to contact. Vague promises of future studies by the states will not meet EPA's obligations.

2. Publication of Strategies

Paragraph 12(c) requires that "the Administrator shall publish the Agency's strategies for reducing or eliminating discharges of toxic pollutants" in each identified water body, and for each pollutant of broad geographical concern. The February 3, 1982 document furnished by Mr. Barrett, titled "Paragraph 12 strategy," is a sham. The document fails to satisfy your obligations in the following respects.

First, the so-called strategy does not specifically address any pollutants or water bodies; it merely calls on the states to make the identifications EPA was supposed to have made. Paragraph 12(c) calls for multiple strategies designed to address the specific problem areas and pollutants identified by EPA. Obviously, EPA cannot meet this obligation until the required identifications have been made. But Paragraph 12 requires EPA, not the States, to make these decisions and to devise appropriate, detailed strategies.

While this violation is clear enough from the face of the February 3 document, I nevertheless questioned your staff about the matter at the March 8, 1982 briefing. Mr. Alec McBride told me that the strategy does not address the 34 areas previously "identified" or any particular area, and was not intended to do so. Furthermore, Mr. McBride said that neither the strategy nor any other EPA policy requires any action (even monitoring) regarding the 12 pollutants "identified" last July.

Second, the so-called strategy is not designed to reduce or eliminate pollution, as required by Paragraph 12. It merely describes an on-going process to review existing state standards, and to adjust those standards wherever possible. Those adjustments might lead to more stringent state controls, or they might result in standards less stringent than those now in effect. EPA characterizes its role as merely providing information and guidance to assist with such reviews in whatever water bodies the states select. The document's mention of EPA's authority to review state standards and perhaps set federal standards does not furnish a strategy for reducing or eliminating specific pollution problems.

Third, the so-called strategy fails to set forth any EPA actions. Paragraph 12 calls for the *Administrator* to take remedial actions for specific problems. Paragraph 12(a) states that "the *Administrator*" shall forthwith establish more stringent controls "pursuant to *his* authority" under Sections 302, 301/303, 307(a) or other authorities. The footnote to this provision explains that "the *Administrator*" is expected to "act" under [the various authorities] "in establishing" more stringent limitations, but that the parties do not agree on "whether the *Administrator* must act under more than one of the authorities." Furthermore, Paragraph 12(c) states that each EPA strategy shall "identify the statutory and regulatory authorities or mechanisms that shall be *utilized by the Agency*" for reducing or eliminating discharges of toxic pollutants. (emphasis added).

EPA's so-called strategy does not meet these requirements. It merely indicates that the *states* may use § 303 water quality standards (as, of course, they may) to deal with any problems they identify. If EPA's strategy is to rest exclusively on water quality standards, *EPA* must act under § 303(c)(4) in order to comply with the Decree. And as we emphasized at the outset, those actions must address specific toxic pollutant problems, not merely call for indefinite studies to see if there are such problems.

Fourth, EPA's so-called strategy contains no schedule. Paragraph 12 states that each strategy must include an estimated schedule for implementation. EPA's document makes no mention of any specific schedule, other than a date for amending generic regulations, and the observation that state standards routinely are revised every three years.

Finally, the strategy has not been published by the Administrator. EPA's February 3, 1982 document was signed by an Acting Assistant Administrator and, to our knowledge, never published. The Decree requires that the Administrator shall publish EPA's Paragraph 12 strategies.

* * * * *

In sum, EPA has failed in every material respect to comply with Paragraph 12. We request a meeting with you to discuss these violations and to consider any solutions you might care to offer. If we do not hear from you within two weeks, we will seek a contempt citation against you.

Sincerely,

J Taylor Banks

J. Taylor Banks

cc: Robert Perry, General Counsel
Susan G. Lepow, Assistant General Counsel
Bruce R. Barrett, Acting Assistant Administrator,
  Office of Water
Barry Neuman, Department of Justice

NRDC
Clean Water

Analysis of EPA Proposals for Amending The Clean Water Act

April 8, 1982

J. Taylor Banks
Fran Dubrowski
Michael Bacon

SUMMARY

1. The Pretreatment Retreat

EPA proposes to: (1) abandon mandatory, national pretreatment standards for toxic industrial discharges into municipal sewage plants; and (2) create waivers for any industries that EPA may choose to regulate. This is a major retreat from the Act's emphasis on uniform treatment technology for industrial toxics. The proposal would eliminate long-standing federal leadership in this area, and place enormous financial and political burdens on the cities by requring scientific and technical investigations for which there are not enough data, methods or technical resources. As a result, the serious toxics problems caused by these discharges will continue.

2. Rollback of BAT Deadlines

EPA proposes to: (1) delay its duty to issue "best available technology" (BAT) regulations for toxics until July 1, 1984; (2) remove its obligation to review BAT rules every year; and (3) roll back industrial dischargers' compliance deadline from 1984 to 1988. These amendments are designed to undermine EPA's court-ordered responsibilities on toxics control, and to give industry an inordinate stretchout of their obligations. EPA has promised a U.S. District Court that it can issue all of the regulations before 1984 -- some as soon as this Spring. Moreover, while dischargers usually need 2-3 years to comply with a rule, EPA's proposal will grant them 4-6 years. For each year that BAT regulations are delayed, EPA has estimated that over 100 million pounds of toxic chemicals will be discharged to the Nation's waters. This is far too high a price for EPA's unjustified delays.

3. Ten-Year Permits: No Further Progress for a Decade.

EPA proposes to increase the maximum term of all Clean Water Act permits from 5 years to ten. This increase will ensure that polluters are protected from more stringent requirements under the Act for a decade. There will not be opportunities to require upgraded treatment -- even if justified by advances in technology, cost-saving innovations, discoveries of new toxics hazards, or decisions by states to increase the protection of their water resources.

4. A Larger Loophole for Federal Facilities.

EPA proposes to expand the President's existing authority to exempt federal polluters by: (1) making such exemptions available for toxics; (2) increasing the legnth of exemptions from one to 3 years; and expanding the authority to cover non-military facilities such as DOE weapons plants. These exemptions are not available for private companies. EPA's proposal creates a loophole in the Act's toxics control program that is not justified by any demonstrated need.

5. Defining Away the Problems Caused by Dams.

EPA proposes to exempt dams from the Act's requirements by simply defining them as "non-point" sources. Discharges from dams cause serious water quality problems, including low oxygen levels that kill fish, sedimentation, depressed temperature and supersaturation. EPA could address the thousands of dams that cause these problems by issuing general permits or broad regulations. Instead, the Agency plans to relegate dams to the now-defunct and bankrupt planning process called 208. The proposal is a non-solution to a serious problem.

6. Making New Sources Into Old Sources.

EPA proposes to apply stringent "new-source performance standards" for toxics only to facilities that commence construction after the standards are issued in final form. These standards can utilize the latest innovations because they do not require retrofitting on existing facilities. The Act now applies those standards to any facility that starts construction after proposal of the regulation. EPA often takes years to promulgate a regulation after it has been proposed, and this amendment would exempt all facilities built during the interim. Where a regulation does not change materially between proposal and promulgation, there is no reason to exempt these sources fron the only standard in the Act designed specifically for plants that are built from the ground up.

7. Relaxing Thermal Discharge Requirements.

EPA proposes to abandon the Act's guarantee that thermal discharges will not undermine the "protection and propagation of a balanced indigenous population of shellfish, fish and wildlife." EPA would provide variances from uniform controls on power plants wherever the thermal discharge satisfies state water quality standards. State standards offer far less protection than the statutory baseline, and are the targets of EPA plans to downgrade and weaken controls even further in the coming months.

8. Lower Authorization of Funding.

EPA proposes to set the authorized funding level for FY 1983 at the amount requested in President Reagan's FY 83 budget. The budget amount is 17% below the Reagan FY 82 budget, which itself represents drastic cuts from prior years. This proposed authorization comes nowhere near the amount needed to carry out clean water responsibilities at the federal and state levels.

9. Non-controversial Amendments.

EPA also proposes to: (a) allow states to assume only partial authority to operate permit programs under the Act; (b) give cities 12 months to apply for stretchouts of their compliance deadlines; (c) collect fees from polluters for processing waivers and exemptions under the Act; (d) give itself authority to assess penalties in administrative proceedings; and (e) add felony sanctions to the Act for negligent or knowing violations that may cause injuries, or for knowing falsification of reports and tampering with monitoring devices.

ANALYSIS

EPA has proposed a 14-point plan to amend the federal Clean Water Act. The plan was sent through inter-agency review by the Office of Management and Budget on March 23, 1982. This analysis does not reflect any changes that might be made by EPA in response to comments by other agencies.

Eight major amendments proposed by EPA would cause drastic, complicated changes in the Act's provisions for controlling toxic industrial discharges into municipal sewers and the nation's waterways. Together with administrative actions already underway at EPA, and with far-reaching amendments proposed by industrial trade associations, these amendments systematically delay and dismantle some of the Act's most important programs. They will mean less pollution abatement, greater administrative burdens on state and local authorities, and serious delays in meeting the Act's objectives.

The discussion below addresses the 14 provisions of the proposal EPA sent to OMB. We consider in detail each of the eight major amendments, and then describe briefly several non-controversial proposals contained in the EPA package.

1. The Pretreatment Retreat.

A. Background

The national pretreatment program is intended to curtail toxic discharges into municipal sewers and treatment plants by over 60,000 industrial sources. These sources are responsible for as much a two-thirds of the heavy metals entering municipal plants, and much greater amounts of other highly toxic chemicals such as cyanide, phenol, and ethyl benzene.

Toxic chemicals cause three kinds of problems when they are dumped into sewers. PASS THROUGH: they can travel through a municipal plant into the receiving waters -- virtually untreated by conventional systems that were designed to handle only domstic sewage. UPSET: they can interfere with municipal plant operations -- upsetting biological treatment processes, causing enormous, untreated discharges of toxic chemicals and domestic sewage, and costing millions of taxpayer dollars to correct. SLUDGE CONTAMINATION: they can contaminate the sludge produced in municipal treatment plants -- rendering it unsafe (without further, costly treatment) for environmentally beneficial disposal such as land spreading.

For these reasons, Congress created the national pretreatment program in 1972, and directed EPA to implement its provisions as expeditously as possible. The program's cornerstone is a system of mandatory pretreatment standards for each of the primary industrial categories. These "technology based" standards merely require industrial sources to use the best treatment technolcgies and controls they can afford. Pretreatment standards should have been issued by 1980 so that industrial dischargers could meet them by 1983.

The standards are to be implemented by municipal authorities (through ordinances, local permits, etc.) after making adjustments (called removal credits) to relax the standards by whatever amount of toxics removal actually (although unintentionally) occurs in the municipal plant.

Although this program was nearly on line by the end of 1980, the Reagan administration stopped pretreatment in its tracks early in 1981. Out of over 20 major industrial categories, EPA has issued only two pretreatment standards (Electroplaters and Timber Products), and some portions of those have been stymied by other regulatory developments. Most important, the "general pretreatment program" regulations were suspended for over a year. First issued in 1978 and re-issued in 1980, these rules govern local responsibilities, removal credits, variances and the like. On OMB's orders, EPA suspended them to conduct a regulatory impact analyses leading to the legislative proposal discussed below.

B. EPA's Proposal.

EPA proposes to change the pretreatment program in three significant ways:

i. Pretreatment standards would become discretionary rather than mandatory. EPA no longer would have a statutory duty to issue standards for any industry, or any toxic pollutant, by any particular deadline.

ii. Waivers could be given for any pollutant in any standard EPA decides to issue. These are not "variances" (to relax standards), but all-or-nothing decisions whether to require any pretreatment at a municipal plant. Municipal operators would not even have to apply for these waivers until two years after the industrial standards are issued.

iii. Program requirements for cities (now contained in the general program regulations) would continue in effect. Those regulations are being overhauled by the administration; this proposal not only would suggest Congressional approval of the changes, but give EPA unlimited time to complete the overhaul.

C. Discussion.

Curtailing (or even delaying) the pretreatment program will carry a very heavy environmental price. According to EPA data, the issuance of standards for 21 major industrial categories would reduce discharges of toxic metals to sewers from 56 million pounds per year to only 9.6 million. Similarly, EPA estimates that by controlling 16 of these industries, annual discharges of toxic organics to sewers will be reduced from 190 million pounds to 61 million.

In total, the difference between issuing standards and witholding them could be over 175 million pounds of toxic pollutants each year -- for as long as they are delayed. The resulting discharges to waterways, interference at municipal plants, and sludge contamination will be significant.

EPA claims that these results can be overcome with a program aimed at local initiative and responsibility. The EPA proposal depends on the ability of cities to: decide where toxics controls are needed; develop these controls on their own; persuade industries to comply; and enforce compliance if necessary. A few cities can accomplish those objectives, but most municipal authorities haven't the expertise, resources or political muscle even to begin. If they cannot accomplish effective pretreatment, then treatment of industrial wastes at the municipal plant will be the only remaining solution -- and that solution means billions of federal taxpayer dollars to effectively subsidize industrial operations.

i. Discretionary standards

EPA's proposal to make pretreatment standards discretionary will accomplish two things. First, EPA will have a better chance of escaping from court-ordered responsibilities to issue standards covering the primary industries and the worst toxics discharged by those industries. Second, the burden of cleaning up these "indirect" toxic discharges will be passed to local authorities -- whether they are equipped to handle the job or not.

EPA has been under court order since 1976 to promulgate these standards. The lawsuits resulting in that order were filed after EPA failed to issue any standards from 1972 to 1975. NRDC and other groups were able to bring these suits only because EPA's duty to comply with the law is mandatory.

Since then, EPA has produced only two industrial pretreatment standards. The standards were due under the court order in 1979, but on three occasions EPA has asked for long extensions. Most recently, the Agency requested until mid-1984 to complete these rules -- even though the technical work and data gathering is finished.

EPA's proposed amendment could elminate all means of keeping pressure on the Agency to issue these standards. If Agency officials chose to ignore the federal role in pretreatment altogether, it might be beyond the reach of federal courts to reign them in. Given EPA's track record and this administration's fear of federal regulation, we would see no more pretreatment standards.

EPA's current position is that upsets and sludge contamination can be addressed solely by the cities under local program requirements, and that the bulk of pass-through problems can be alleviated by issuing standards for only two industries (Metal Finishers and Organic Chemicals produucers). The Agency is wrong for several reasons. First, pretreatment standards are necessary to deal with upsets and sludge. They serve as insurance against the (now demonstrated) likelihood that cities cannot solve these problems on their own. Second, EPA has not shown that regulations for two industries will reduce toxic pass-through to acceptable levels. EPA data show that 35 million pounds of toxic metals and organics would still be discharged to receiving waters under those regulations each year, and another 72 million pounds would enter municipal sludges. Moreover, those estimates assume unrealistically high rates of toxic removals by the municipal plants that cannot be expected to occur nationwide -- especially after EPA relaxes secondary treatment requirements (discussed below).

The upshot is that EPA hopes to place almost all pretreatment responsibility and resource burdens on local governments. A few large cities (Los Angeles, St. Louis and others) have done reasonably well on their own. But EPA estimates that at least 2,000 municipal plants need effective pretreatment programs. The EPA proposal will eliminate any hope of meaningful federal assistance or leadership in establishing those programs.

According to a recent study of cities that have implemented pretreatment programs, federal requirements are the primary motivation for developing those programs. For example, the Washington Suburban Sanitary Commission recently commented to EPA that the existing pretreatment program, "while establishing an important national policy for the control of nondomestic wastes discharged to [municipal plants] provided WSSC with the impetus to develop a formal pretreatment program." And another municipal authority, reacting to EPA's suspension of the general program regulations, stated, "we feel efforts would be better spent on categorical pretreatment standards rather than on minor technical changes in the general regulations."

State officials are even more emphatic in their call for a uniform national program. The Director of Connecticut's Department of Environmental Protection has urged EPA to implement an effective national program quickly. He wrote, "One of the main problems we have had in enforcing [Connecticut's pretreatment program] over the years has been that the affected Connecticut industries have been placed at a distinct economic disadvantage when compared to their competitors in other states where pretreatment programs are not in place." And according to Wisconsin's Pretreatment Administrator, "the National Pretreatment Program should proceed without further delay and uncertainty. In our opinion, there is a continuing need for the regulation of industrial wastewaters sent to publicly owned treatment works."

As these comments demonstrate, cities face two major problems with their local pretreatment programs. First, because EPA continually delays the national standards, cities cannot convince their industries to meet local requirements -- particularly if neighboring cities are not imposing controls. Why should a plant install expensive equipment to comply with a local pretreatment ordinance when its competitor has no such burden, and when EPA might issue different standards next year or the year after? EPA's proposed amendment will exacerbate this guessing game; industries will not even know whether they will be regulated, let alone when or to what degree.

Second, most cities do not have the technical resources, research capability, or administrative staff to devise and implement pretreatment controls. EPA is banking on the cities to decide: whether pretreatment is needed; which industrial sources to control; and the degree of treatment required to protect stream quality, plant operations and sludge. All of these questions are difficult and resource-intensive, and that is why Congrses chose to address them under mandatory, national pretreatment standards.

Without pretreatment standards and federal resources, the cities will flounder. There are few toxics stream standards and no sludge guidelines for cities to use as benchmarks in deciding whether to control industrial sources. One quarter of all municipal plants have interference and upset problems (for which they blame industrial users), but almost none of the plant operators knows the real cause or source. Nearly 90 percent of the plants in one recent study reported sludge contamination caused by industrial dischargers, but one out of three had no quantitative knowledge of the problem. And only one in three municipal plants even monitors its influent for metals or toxic organics.

The need to gather this knowledge comes as no surprise. Cities have had these responsibilities -- and complete legal freedom to carry them out -- for several years. The fact that many have not met the challenge indicates that they are unable.

In sum, the cities are not uniformly capable of maintaining a strong pretreatment program, and EPA appears to be unwilling to meet its obligations. The one way to ensure that this program gets off the ground is to retain EPA's mandatory duty to issue national standards.

ii. Waivers

If EPA decides to issue standards, the Agency's proposal then affords industries a second bite at the apple -- an opportunity to have their standards waived. EPA's waiver provision would result in tremendous administrative burdens on permit agencies, and produce long delays in compliance. The waiver supposedly would be granted only where pretreatment standards are not "needed." In reality, the proposal depends on determinations of need that either cannot be made, or that easily can be adjusted to produce an illusion that pretreatment is unnecessary.

(a). Resource burdens.

Processing these waivers will require enormous commitments of resources by state and local governments. Over 60,000 industrial facilities discharge into municipal plants, but if EPA chooses to regulate only Metal Finishers and Organic Chemicals and Plastics producers, over 10,000 dischargers could be involved. If only a fraction of these sources seek waivers, the administrative burdens, red tape and delays will be enormous.

EPA has estimated the resources it would take to process permits with waivers from "best available technology" (BAT) effluent limitations. The Act requires that pretreatment standards be analogous to BAT. Since EPA's proposed pretreatment waiver is at least as scientifically complex as a BAT waiver, these estimates are useful for predicting the burdens associated with EPA's proposal.

Using EPA's estimates, permit writers could be required to invest up to 8 work months for an uncontested proceeding, and over 40 work months if the proceeding drags through administrative and judicial hearings. If only 2,000 pretreatment waivers are sought, and only half are contested, the resources would run up to 4000 work years just to handle the technical and scientific investigations, and of course the paperwork. Over a five-year period, it would take about 800 professionals to handle such a burden.

EPA also has some direct experience with waiver-type proceedings. The Agency has considered a number of variance applications under its permit regulations, and the experience led to some sobering predictions. A recent EPA memorandum, for example, observes that:

> EPA action on variance requests is highly resource intensive, and a significant increase in the number of variances would serve to upset

> permitting priorities and our ability to reduce the backlog of expired industrial permits. The Office of
> Water Enforcement and Permits estimates that consideration of a major industrial variance requires 65
> work-days per permit. Together with the time needed to draft the initial permit, this would triple the resource requirements for each permit. (This does not include any estimate of resources required to defend Agency action in evidentiary hearings or court challenges.)

These estimates are for variances that are quite simple compared to the waiver being proposed by EPA.

Finally, EPA's pretreatment waiver is not unlike the development of case-by-case discharge permits under the Act based on "Best Professional Judgment." These BPJ permits are the only way a state has to regulate chemical discharges when EPA fails to issue uniform, industrial effluent limitations. Thus far, almost all states have refused to undertake this task, and instead have simply "rolled over" old permits for non-toxic pollutants that were developed in the early 1970's. State officials say they have neither the technical resources nor the ability to withstand lawsuits. They are waiting on their federal partner to issue uniform regulations.

(b) EPA's Waiver Conditions

The conditions in EPA's proposed waiver appear calculated to generate controversy and delay. They require decisions for which there are no suitable benchmarks and for which administrative manipulation would be easy. These problems --

together with the two-year grace period before applications are even due -- guarantee that pretreatment standards (if any are issued) will not be met for many years.

The EPA waiver provision has five primary conditions; a waiver would be granted if:

1. The municipal plant is in compliance with secondary treatment, water quality standards, general pretreatment program requirements and, if applicable, ocean discharge criteria.
2. Designated uses for the receiving waters are being attained by the municipal plant, and will be maintained under the waiver.
3. The waiver would cause no interference with sludge use and disposal guidelines.
4. The waiver will not subject any other source (direct, indirect, or non-point source) on the waterway to additional requirements.
5. Existing water quality will not be degraded.

These conditions might appear to be fairly strict -- until one examines their bases and EPA's stated plans to manipulate them.

Compliance with secondary treatment. No waiver of pretreatment standards should even be considered unless the municipal plant is achieving secondary treatment. EPA's entire premise is that secondary treatment accomplishes some removal of toxics. At present, secondary treatment ensures that municipal plant effluents contain no more than 30 mg./liter of biochemical oxygen demand (BOD) and suspended solids (SS), and that the plant removes at least 85% of these pollutants from the raw wastewater.

EPA claims that secondary treatment removes approximately 60% of the metals and 70% of the toxic organics in municipal plants. In fact, the limited data on which EPA relies demonstrate that: (1) significant information is available for only about one fourth of the toxics actually detected in municipal plants; (2) the results used to derive these estimates frequently leave 50 to 100% of each pollutant unaccounted for; (3) the variation of removal efficiencies for individual pollutants at municipal plants is enormous; and (4) in any event, the studies included only well designed and operated plants that almost never have to be by-passed when heavy rains cause sewers to overflow. These estimates are no better than educated guesses.

More important, however, the Agency's proposal fails to mention EPA's plans to "re-define" secondary treatment. EPA will either remove the 30 mg./liter limit or increase it, and will eliminate the 85% requirement or decrease it. On December 17, 1981, EPA officials began circulating a draft notice of proposed rulemaking that could change the 30 mg./liter limit to 50, and change the 85% removal requirement to 75% (if it is retained at all). The draft acknowledges: that existing plants could backslide under the proposal; that "less stringent BOD and SS standards [would] result in less toxics removal;" and that without the 85% requirement, secondary treatment could be met through dilution rather than treatment.

With these kinds of administrative changes, this condition on the pretreatment waiver would provide no assurance of protection against toxic discharges by municipal plants. The suggested 75% removal and 50 mg./liter limits could be met by less-effective biological treatment or "chemical advanced primary" processes. With less-effective biological treatment (*e.g.*, trickling filters, oxidation ponds) municipal plants would achieve lower removals of biodegradable organics (benzene, phenols) and any toxics that adsorb to suspended solids (cadmium, mercury). There would be major drops in the removal of volatile organics. With chemical advanced primary, plants might do better on metals, but would not remove biodegradable organics or volatiles at all.

Compliance with water quality standards. Requiring compliance with state water quality standards provides virtually no protection against toxic discharges. Pretreatment standards are supposed to address a broad variety of toxic metals, organic chemicals and other toxic compounds. But states do not have standards for most of these substances, and there is little hope that meaningful standards can or will be established any time soon. As EPA put it in a recent document, "EPA and the states cannot make waiver decisions based on the existing designations of segments .... These designations were developed for conventional [non-toxic] pollutants."

Fewer than 20 states have any numerical standards for toxics. Those that do usually cover only a handful of heavy metals, and almost never consider chronic toxic effects or human exposures through the food chain. Only 16 states have quantitative standards for lead, cyanide and cadmium; fewer than 15 have a PCB standard; and only six have a standard for silver. Most of these standards are considerably less stringent than EPA's national criteria, and the range of values (for any given pollutant) across the states is considerable. In EPA's recent Regulatory Impact Analysis of the pretreatment program, this sorry state of affairs led the investigators to conclude that "state water quality standards are too limited for determining the national water quality impacts of industrial users."

The only hope of correcting this situation is for EPA to: (1) provide the criteria upon which states could set standards; and (2) insist that states address toxic pollutants. Neither of these actions is being taken.

EPA's national criteria are far from complete. Out of 129 priority toxic pollutants, EPA has established aquatic life criteria for only 21 . Deputy Administrator Dr. John Hernandez has belittled these criteria repeatedly as scientifically unsound. And recently, the Agency went to court trying to escape from its legal duty to issue the remaining criteria. Instead, EPA is preparing a set of "protocols" that will assist the states in deriving less-stringent "local" criteria.

Similarly, EPA is not taking steps to see that state standards include the most important toxics. The Agency has never followed a policy of requiring states to address any particular pollutant in their standard setting. Last year EPA identified 12 toxics as deserving national attention, but its published strategy for improving water quality contains no requirement that those pollutants be considered by the states.

Compliance with general pretreatment program requirements. This condition requires that municipalities undertake at least minimal efforts to identify their industrial users and prevent the discharge of chemicals that could cause explosions, corrode pipes, or emit dangerous fumes at the plant. These requirements, while necessary, do not address the central problems of toxic chemical pass through, interference, and sludge contamination. Since local plant operators have a difficult time even finding the sources of these problems, Congress decided to address them through the standards being waived.

Attaining and maintaining designated uses. This condition also appears to be stringent, but behind it lies another significant EPA action. The Agency is preparing to change its regulation governing how states determine the uses they will seek to protect under their standards. The new regulations, termed "use attainability" by EPA, will focus on reconsidering the states' existing designated uses to determine whether they can or should be "attained." Since most streams in the country are designated for the highest use under the Act -- "fishable-swimmable" water quality -- that means systematic and widespread downgrading to less-desirable designations such as agricultural and industrial uses. EPA will rely on quick and dirty cost-benefit analyses to justify these actions.

EPA's draft regulation eliminates long-standing EPA policies to protect water quality. It wipes out the antidegradation concept. It removes existing barriers to downgrading beneficial uses. And it eliminates special protections for outstanding national resource waters such as those found in national parks. It even suggests that good water quality need not be protected where a stream is physically too shallow for swimming and canoeing.

These changes will devastate any proposal that relies on water quality standards as the environmental "baseline." Together with the lack of any numerical state standards for toxics, it undercuts any value this supposed waiver condition might have had.

No interference with municipal plant operations. EPA's proposal requires that the waiver cannot result in interference with municipal plant operations. As we mentioned earlier, most cities do not know which industrial sources are causing upset and interference problems at their plants. It may be that these problems are due to one or more sources in combination, or that various sources cause interference at certain times but not at others. Since it is neither easy nor inexpensive to answer such questions, there will be a strong tendency for each source to claim it is innocent, and to put the cities and EPA to their proof. That proof will be hard to come by.

Compliance with sludge guidelines. Waivers of pretreatment standards will ensure that high levels of toxics continue to enter municipal plants. Consequently, the sludges created by those plants will continue to be contaminated. Nearly 90% of municipal plants surveyed in one recent study had sludge contamination problems caused by industrial discharges, and that is not likely to change if pretreatment standards are waived.

EPA's waiver condition -- that § 405 sludge guidelines are met -- is meaningless. Despite protracted litigation by environmental groups, there are no such guidelines, and EPA has not suggested a firm target date for their issuance. At present, the Agency has a task force studying options for a policy statement on sludge disposal.

Even if guidelines are established, they will not ensure that municipal sludges are kept sufficiently free of toxics to allow beneficial disposal techniques. The guidelines will merely set limits for whatever disposal technique is being practiced by the municipal authority. Any tough guidelines (e.g., for land disposal and composting) may well mean that pretreatment would be required before those disposal options become viable. That being the result, municipalities will be faced with strong disincentives to adopting those techniques -- i.e., denial of pretreatment waivers.

No additional requirements on other sources. This condition will place a duty on the permitting authority to determine whether granting the waiver for a given industry requires other sources to take up the slack. Since a waiver means maintaining the status quo, and since water quality standards must be met, this provision would not necessarily affect existing sources in the immediate area. It will have a significant meaning, however, in two situations. First, if water quality standards are just barely being met, then any new source in the area would be affected by the waiver. Its allocation of pollutants to the stream might already be absorbed by the waiver applicant. Second, if standards for downstream segments of the water body are not being met, the waiver could mean that downstream sources have to shoulder a larger burden than they otherwise would in complying with their requirements.

Both of these situations have to be "predicted" by the permitting agency, and that means wasteload assessments and allocations will be necessary. These not only require enormous resources, but without the benchmarks (water quality standards) and the tools (sophisticated computer models and knowledge of persistence, synergism, etc.), such predictions are shaky at best, and usually impossible. The states' and cities' attempts to consider these factors will result in delay, expense, and protracted litigation.

No diminution of existing water quality. This condition is neither as simple nor as protective as it appears. It will produce unending scientific and policy debates, and require vast resources to implement. As EPA officials observed recently regarding BAT waivers,

> While EPA could develop guidance describing conditions where environmental waivers would have a high probability of approval, it may not be easy to develop an actual testing program for environmental waivers that would be satisfactory. A testing program determining "no adverse effects" is most easily developed for simple situations (e.g., one discharger) and even that would involve extensive lab and field work.
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> Although ecological assessments are scientifically possible, individual scientists often make different assessments from the same data because few if any of the biological methods involved in field and lab assessments are standardized. Therefore, the quality of the results can strongly depend upon the expertise of those designing and conducting the assessment. This could cause inconsistencies among stream segments.

Numerous complications will arise under this waiver condition. For example, a waiver could permit discharges of toxics at current levels that will continue to build up in sediments and fish tissues. Is that a "diminution" of water quality? An adequate margin of safety should be built in to account for degradation caused by increases in non-point source runoff and new-source dischargers. Does EPA plan to do so? Waivers should be subject to change if new monitoring capability or other advances subsequently show that water quality is being degraded. Can the waivers be re-opened during the (proposed) ten-year life of the municipal permit? How far downstream will EPA apply this non-degradation condition? Is the waiver a license to avoid tougher standards if the state chooses to upgrade them later? Each of these questions and concerns suggests complications, resource burdens, and major policy choices for Congress and EPA.

Timing. Under EPA's proposal, waiver applications need not be filed until 3 years after the amendment is enacted, or 2 years after standards are issued, whichever is later. The proposal contains no deadline for issuing standards, but EPA's most recent schedule under the NRDC v. Gorsuch Consent Decree would extend deadlines out to as late as June, 1984. Consequently, waiver applications would be due in 1985 or 1986.

Pretreatment standards ordinarily must be met within three years following promulgation. But if EPA's proposal suspends the compliance period, two of those 3 years will elapse before EPA even receives the application. And processing waivers easily can consume a year or more -- even without the inevitable litigation. Consequently, standards which should be met by 1987 under EPA's current promulgation schedule, may be met as late as 1990 -- that is, if any standards are issued to begin with.

2. Rollback of BAT Deadlines.

A. Background

Effluent limitations requiring the use of "Best Available Technology" (BAT) are the centerpiece of the Act's strategy for controlling direct, toxic industrial discharges. The 1977 amendments required EPA to issue BAT regulations for a specified list of toxic pollutants no later than July 1, 1980. Industrial dischargers are allowed until July 1, 1984 to comply with these regulations.

EPA's specific schedule for promulgating these industrial regulations is governed by the Consent Decree in *NRDC v. Gorsuch*, entered by a U.S. District Court in 1976 and modifed in 1979. The 1976 Decree required that these rules be issued before 1980. Under the 1979 modification, all rulemaking was to have been completed by May 1981.

EPA has issued only one regulation out of over twenty that are required, and has fallen seriously behind its own schedule. In August 1981, EPA asked the court for extensions out to November 1983. Even the early dates in this requested schedule have been missed, and in March of this year EPA asked for further delays. The current EPA schedule -- not yet approved by the court -- would extend to June 1984.

The history of these delays is illustrated by the attached chart.

B. EPA's Proposal.

EPA proposes to extend its own deadline for promulgating BAT limitations until July 1, 1984, and to drop the Act's current requirement that these rules be reviewed and, if necessary, revised every year. This new deadline would apply to all of the industry regulations.

EPA also proposes to extend industry's compliance deadline from July 1, 1984 to July 1, 1988 for BAT regulations covering listed toxic pollutants, conventional pollutants or nonconventional pollutants. Industry would be required to meet any other limitation (e.g., those established case-by-case in a permit) within three years after it is established.

C. Discussion

i. Promulgation deadline. EPA's proposal to extend its promulgation deadline is a blatant attempt to escape from court-ordered responsibilities. The new 1984 deadline is calculated to furnish EPA the excuse to seek a modification of the Consent Decree, citing Congressional approval of this new leeway. And even though the statute would read: "as soon as practicable, but not later than July 1, 1984," prior experience shows that the proposed date would become EPA's new "least common denominator".

_If_ EPA can be taken at its word, this extension is not needed across the board. Even the Agency's most recent request for delay (not yet approved by the court) promises that some regulations will be issued very soon: _e.g._, Iron and Steel, May 1982; Inorganic Chemicals and Paint Formulators, July 1982; Petroleum Refining and Textile Mills, September 1982. _Every_ date in EPA's current schedule is earlier than July 1, 1984, and the plaintiffs in the litigation are not yet convinced that these delays are necessary. But even under the worst case, this new deadline could mean as much as two years of delay in promulgating some of the most important regulations (_e.g._, Iron and Steel).

ii. _Compliance Deadline_.

It is generally accepted that industrial dischargers need two to three years after a limitation is established to bring themselves into compliance. EPA's proposed catch-all provision confirms this view by providing three years in all cases not governed by the suggested 1988 deadline.

Given EPA's current, staggered schedule for issuing BAT regulations, the 1988 compliance deadline makes no sense at all. EPA has promised the court that even the last regulation will be issued by June 1984 (Organic Chemicals); this suggested compliance deadline would give that industry over four years to meet its requirements. The Iron and Steel industry, at the other end of EPA's promulgation schedule, would get over six years -- twice the usual compliance period.

EPA's proposal guarantees that toxic chemicals will be discharged by industrial sources for considerably longer periods than necessary. In the Iron and Steel industry, for example, a recent EPA report estimates that the difference between current annual discharges and discharges with BAT treatment will be over 3.8 million pounds of toxic metals and over 4.5 million pounds of toxic organics -- a total of over 8 million pounds each year. If EPA's estimates are correct, giving this industry 6 years to comply rather than 3 results in 25 million pounds of toxics needlessly discharged to the environment.

EPA projections for all of the primary industries show that nearly 38 million excess pounds of metals and 80 million excess pounds of toxic organics will be discharged during each year that BAT controls are delayed. If the average delay is just one year, our nation's waters will receive well over 100 million pounds of toxics that otherwise would not have been discharged. This is far too high a price to pay under EPA's deadline rollback.

3. Ten-Year Permits: No Further Progress for a Decade.

A. Background

The Clean Water Act authorizes EPA and state agencies to issue permits for a maximum term of five years. Congress chose this duration for a good reason -- standards and other requirements under the Act are supposed to change relatively frequently, and new permits should be issued promptly to incorporate any more stringent controls. New treatment technologies will emerge; the costs of existing technologies will go down; and better scientific knowledge about ambient pollutant effects will demonstrate the need for tighter controls. For example:

- BAT regulations are supposed to be reviewed and, if necessary, revised every year;
- Pretreatment standards should be revised "as control technology, processes, operating methods, or other alternatives change;" and
- Water quality standards must be reviewed and revised every three years.

Five-year permits make it possible to incorporate these revisions as they become appropriate.

In practice, however, five-year permits routinely last for seven or eight years. Most of the BPT permits were issued in 1973-74, and because EPA's BAT rules are overdue, they are still in effect. EPA and the states either extend these permits, or they allow expired permits to continue under provisions of the Administrative Procedures Act and similar state laws.

B. EPA's Proposal

EPA proposes to allow all permits (municipal and industrial) to extend for 10 years rather than five.

C. Discussion

EPA's proposal would give existing sources the same period of protection Congress chose to grant new sources, whose risks are greater because new-source standards are supposed to require the most innovative control techniques. It is premised on two arguments: (1) that dischargers need the longer permit term to insulate them from additional controls; and (2) that permit writers need relief from the current workload.

EPA has not demonstrated that existing dischargers need this protection; they have merely asserted it. For example, in at least five of the primary industries, EPA plans to issue BAT rules that are no more stringent than the BPT limits facilities were supposed to have met by 1977. The ten-year term would freeze over 11,000 permits in these industries, at 1977 levels, until 1992 or beyond. And given the historical tendency for five-year permits to evolve into seven-year permits, this protection period could be much longer.

Likewise, ten-year permits will not ease permit writers' log jams; they will simply postpone the workload. The logjam will be broken only if EPA follows its phased schedule for promulgating BAT regulations, and if industrial compliance deadlines are pegged to that schedule (e.g., three years after promulgation or issuance of BPJ permits).

What is really at stake, however, are opportunities to upgrade a discharger's requirements as the need arises over the next decade. In the 1981 construction grants amendments, for example, Congress required that all state water quality standards be reviewed and revised by the end of 1984. Those revisions should include new criteria for toxic chemicals, but if ten-year permits are issued during the next two years, those criteria will not find their way into permits until the early 1990's.

Similarly, EPA is obligated to decide, by mid-1983, whether there are additional toxics, not now on the priority list, that should be controlled in industrial discharges. Hundreds of additional substances are on the Agency's current working list. If rules are issued by the mid-1980's to govern these chemicals, they will be useless for at least 5-6 years while 10-year permits continue to protect dischargers.

EPA's proposal would put technological and environmental progress on hold for a decade. It has not been justified by any showing of need, and should not be adopted without careful consideration of the consequences.

4. A Larger Loophole for Federal Facilities

A. Background

Section 313 of the Act requires federal facilities to stand on equal footing with all other polluters in meeting abatement requirements for their discharges. They are subject to the same "Federal, State interstate and local requirements, administrative authority, and process and sanctions ... as any non-governmental entity ...." The Act permits states to impose any necessary requirements that are more stringent than federal controls, and federal facilities must meet those requirements.

The President may exempt any federal "effluent source" in the executive branch from these requirements for one year under certain limited circumstances. The President must determine that an exemption is "in the paramount interest of the United States." The most important limitations on this authority are: (1) exemptions cannot be granted from new-source standards, toxic effluent limitations, toxic effluent standards or pretreatment standards issued under §§ 306 and 307; and (2) exemptions are for only one year.

In addition, the President may issue regulations at three-year intervals exempting weaponry, equipment, aircraft, vessels, vehicles or other property that is owned or operated by the U.S. armed forces or state national guards, and that are "uniquely military in nature." These regulations also must be justified by a Presidential finding that the exemptions are "in the paramount interest of the United States."

B. EPA's Proposal

EPA proposes to enlarge the Presidential exemption authority in four significant ways.

- Exemptions for "effluent sources" would be available with respect to all EPA regulations governing toxic discharges: new-source standards, BAT toxic effluent limitations, toxic effluent standards and pretreatment standards.
- Exemptions for "effluent sources" would last for three years rather than one.
- Regulations granting three-year exemptions would cover all facilities, not merely weaponry, equipment, aircraft, vessels, vehicles and the like.
- Regulations granting these three-year exemptions would cover non-military government facilities as long as those facilties "are essential to the maintenance of operational capabilities of the Armed Forces of the United States."

C. Discussion

Each of the four changes could have serious consequences for the reduction of toxic discharges. The first two (expansion of exemptions to cover toxics, and extension from one to three years) obviously cut directly against established Congressional policies. Congress intentionally singled out toxics for control across the board, no matter who the polluter happens to be. And the Act restricts this presidential exemption to one year so that the primacy of states in issuing tougher standards every three years will not be thwarted. Neither of EPA's proposals to change these policies has been justified.

The third and fourth proposals (regulations exempting non-military government facilities) appear to be designed specifically to accommodate Department of Energy weapons facilities. The proposal would cover any such facilities owned or operated by DOE, and it would include toxic discharges from those facilities. Again, Congress will have to weigh carefully the wisdom of this loophole.

5. Defining Away the Problems Caused by Dams.

A. Background

The Act prohibits the discharge of pollutants by point sources except in compliance with a permit that implements effluent limitations, water quality standards and other requirements. Point sources are defined to include "any discernable, confined and discrete conveyance."

In a case brought against EPA by the National Wildlife Federation, a U.S. District Court recently ruled that man-made dams can be "point sources," can "discharge pollutants," and thus are required to have permits under the Act.

Dams often release water from deep within the reservoir that has much less dissolved oxygen than downstream waters.

These discharges can violate water quality standards and destroy aquatic life -- sometimes causing large fish kills -- and they can inhibit the downstream waters' ability to cleanse itself by breaking down organic matter discharged from sources below the dam. In addition, discharges from dams can include harmful forms of metals, seriously decreased temperatures, increased sediments, and supersaturation.

There are 50 to 60 thousand large dams in the country, and over two million dams in all. The court stressed that EPA need not issue a permit to each dam -- only those that cause pollution problems -- and that many administrative options are available to EPA, including categorical exemptions, areawide permits and general permits.

B. EPA's Proposal

Having lost in court, EPA now proposes to define away the problems caused by dams. The Agency's proposal is straight forward: change the Act so that dams are specifically defined as non-point sources rather than point sources. This amendment is similar to the fix obtained by irrigators in the 1977 Clean Water Act amendments.

C. Discussion

The water quality problems caused by dams can be defined away, but they obviously will not go away. EPA could have used the administrative flexibility cited by the Court to do something about those problems, as it has with offshore oil rigs, feedlots and storm sewers in the past. Instead, EPA proposes to relegate these problems to the trash heap commonly referred to as non-point source "controls."

EPA's proposal will add dams to the list of non-point sources to be studied under § 208(b)(2) of the Act. Planning agencies will be asked to "identify, if appropriate, changes in the quality, movement, flow or circulation of any navigable waters including changes caused by the existence or operation of dams."

It is common knowledge that § 208 has never resulted in meaningful plans, let alone controls, for non-point sources of pollution. The program has worked so poorly that neither the administration nor Congress is eager to provide future funding. EPA's proposed authorization contains no funding for § 208.

The assignment of dams to this never-never land would guarantee that these water quality problems are forgotten by EPA and State agencies. If Congress is serious about controlling point sources through the permit process, it will reject this proposal and encourage EPA to pursue its flexible administrative options.

6. Making New Sources Into Old Sources.

A. Background

The Act prescribes stringent standards of performance for new industrial dischargers (new sources). Because these sources are built from the ground up, they have greater flexibility than existing dischargers to use the most innovative treatment technologies and process controls to curtail their toxic discharges. In return for meeting these more stringent requirements, new sources are granted 10-year permits rather than the usual five.

Section 306 of the Act defines a new sources as "any source, the construction of which is commenced after the publication of proposed regulations prescribing a standard of performance ... if such standard is thereafter promulgated in accordance with this Section." (emphasis added). Section 306 also says that EPA must publish final standards within 120 days after the proposal.

Through its regulations, EPA has turned this definition upside down. Seizing on the language "if such standard is thereafter promulgated in accordance with this section," EPA says that the proposal date
no longer triggers the definition whenever the Agency misses its 120 day promulgation deadline. Since EPA always misses the deadline, new sources are now those which commence construction after promulgation, not proposal.

The significance of this interpretation is not minor. EPA routinely misses its 120 day deadline, not by weeks or months, but by years. For example, EPA proposed new-source standards for offshore oil platforms in 1975, but they will not be issued finally until 1983. When such delays occur, no source which commences construction during the interim is considered a new source under EPA's interpretation. They need only comply with BPT or water quality standards, not new-source standards.

Moreover, the Act directs EPA to comply with NEPA in issuing a permit to any new source. This additional requirement is an important tool with which to assess siting problems and other environmental impacts that are uniquely avoidable for new sources. EPA's interpretation makes this tool unavailable.

NRDC has sued EPA twice over this interpretation. Where standards do not change materially between proposal and promulgation, we see no reason why Congress' intent should not be carried out by applying these standards to new sources of pollution, as § 306 provides. Both cases are pending in the U.S. Courts of Appeals.

B. EPA's Proposal

EPA has proposed to change the definition of a new source by conforming the Act to EPA's interpretation. A new source would become any source which commences construction after promulgation of the standard.

C. Discussion

The EPA proposal is designed specifically to defeat NRDC's litigation. It could affect the quality of effluents from thousands of new discharges. During the next year or two, EPA is required to issue new-source standards, under the NRDC v. Gorsuch Consent Decree, for all of the primary industries. These standards will specifically address toxic pollutant discharges from many categories of sources -- some for the first time. Every new facility for which construction commences between proposal and promulgation will escape those regulations. Given EPA's long delays thus far, a large number of plants could slip through EPA's loophole.

This proposal makes a significant step toward mortgaging the future. It stifles Congress' determination to seize the only real opportunity for wise planning decisions and truly stringent requirements based on the most innovative treatment processes available.

7. Relaxing Thermal Discharge Requirements

A. Background

The Act defines the term "pollutant" to include heat, so like any other pollutant the thermal component of a discharge is subject to BPT, BAT, water quality standards and new-source standards. The Act has a special section (316), however, that permits a modification (*i.e.*, a variance) of these requirements (except for water quality standards).

The variance depends on a showing by the discharger that its requirements are more stringent than "necessary." If EPA or a state grants the variance, they must demonstrate that the modified requirements are stringent enough.

The key, then, is how one decides what is "necesssary" and what is stringent enough. The Act establishes an important benchmark for these decisions; it requires that thermal discharges assure "the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on that body of water." (emphasis added). EPA calls this benchmark a BIP.

This phrase is found, with some variation, throughout the Act. Its roots are in the "national goal" set forth in § 101(a)(2). It is a prominent part of the formula for deriving "water quality related effluent limitations" under § 302 for use when BAT proves inadequate to protect water quality. And it comprises an important portion of the "floor" below which EPA cannot go in granting variances from BAT (§ 301(g)) or from secondary treatment for coastal municipal plants (§ 301(h)).

This phrase, particularly as part of the variances in which it is found, maintains an environmental minimum for decisions to depart from technology-based controls. It is closely linked to what is called "the objective of this Act": "to restore and maintain the chemical, physical and biological integrity of the Nation's waters." In the House Report on the 1972 legislation, Congress explained this concept as follows:

> Although man is a part of nature and a product of evolution, 'natural' is generally defined as that condition in existence before the activities of man invoked perturbations which

> prevented the system from returning to its original state of equilibrium.
>
> This definition is in no way intended to exclude man as a species from the natural order of things, but in this technological age, and in numerous cases that occurred before industrialization, man has exceeded nature's ... ability to respond to change. Any change induced by man which overtaxes the ability of nature to restore conditions to 'natural' or 'original' is an unacceptable perturbation.

(emphasis added). The "balanced indigenous population" (or BIP) standard is Congress' embodiment of this concept as an environmental baseline.

B. EPA's Proposal

EPA proposes to substitute for this standard the requirement that thermal discharges merely assure attainment or maintenance of state water quality standards or, where applicable, satisfy ocean discharge criteria. Modifications granted under § 316 would turn on this new, relaxed standard, but would not be permitted to diminish "existing water quality."

C. Discussion

EPA's proposal is an attempt to satisfy the utilities, led by the Edison Electric Institute, in their years-long battle to gain relief from thermal discharge requirements, and particularly from the need to use cooling towers. The new provision would abandon one of the most fundamental environmental principles in the Act. In place of that principle, EPA would substitute a mechanism -- state standards -- that is subject to all of the manipulation and downgrading described earlier (see discussion of pretreatment waivers).

After EPA assists the states in downgrading their standards, some lakes and rivers will have no real protection at all. Thermal waivers will have no meaningful, environmental baseline. A stretch of river designated for agricultural use or industrial operations, for example, would not have standards to protect fish and shellfish propagation. This new EPA standard will permit the destruction of aquatic life wherever such downgrading takes place.

The EPA proposal includes a second floor: no diminution of water quality. While appearing to be protective, this requirement in fact will act as a brake against improving water quality. Moreover, it will perpetuate the same, difficult and resource intensive controversies over water quality analysis that we described earlier (see discussion of pretreatment waivers). It was to avoid these controversies, and the delays they cause, that Congress adopted technology-based controls in the first place -- the very controls that would be waived under this provision.

These waivers are from BAT and new-source standards. Since neither has been implemented for power plants, the effect of a waiver is to preserve the status quo. Naturally, water quality will remain the same (the water will not get warmer) under a waiver of these controls. The point is, however, that these controls are supposed to improve water quality so it can support balanced indigenous populations of aquatic life.

EPA's "no diminution" standard proposes that we accept water quality the way we find it today, and relinquish the principle of improving that quality to the point where aquatic conditions can obtain their natural equilibrium. It is a sobering proposal, and one that requires a good deal of Congressional soul searching.

8. Lower Authorization of Funding.

A. Background

Funding for Clean Water Act programs must be reauthorized, and to its credit EPA has proposed a five-year term of authorization. The duration and funding levels of the reauthorization are critical to the success of EPA's programs, for without the necessary stability and resources this Agency cannot carry out Congress' intentions.

B. EPA's Proposal

EPA proposes to set the authorized funding level for FY 1983 at the amount requested in the President's FY 83 budget (a total of $146.3 million). For Fiscal Years 1984 through 1987, EPA proposes "such sums as may be necessary."

C. Discussion

The President's FY 1983 budget should not be Congress' reference for the authorization level. It is $24.7 million (17%) below the Reagan Administration's FY 82 budget estimate, which itself represents a drastic cut from funding for prior years. And it calls for the loss of 18 full-time personnel (out of 170 in FY 82) to implement water programs. EPA and the states cannot be expected to carry out their responsibilities, let alone new responsibilities added by these amendments, with reduced resources.

9. Non-controversial Proposals

EPA has proposed to amend the Act in several minor ways that would provide technical, non-controversial changes. The following discussion outlines the highlights of these proposals.

A. Partial delegation. The EPA proposal would allow states to seek partial delegation of NPDES permit programs. Partial programs could be approved by major components such as pretreatment, federal facilities, municipal vs. industrial dischargers, or by industrial category. Approval of partial programs would depend on a state's commitment to assume full delegation within 5 years. The proposal would not allow currently approved states to relinquish portions of their programs, or permit EPA to partially withdraw its approval.

B. Extension of Time to Apply for Stretchouts of Municipal Compliance Deadline. Last year, Congress provided that cities facing problems meeting secondary treatment requirements could apply for a stretchout (until 1988) whenever their difficulties were caused by reduced federal funding that made it impossible to comply by 1983. Congress forgot to extend the deadline in the Act (1978) for making these applications. EPA proposes to set a deadline of 12 months after enactment of the 1982 legislation.

C. Waiver Fees. EPA proposes to authorize the Administrator and the states to collect fees from any applicants for waivers and exemptions under §§ 301(c), (g), (h), 307(b) and 316(a). The amounts would be whatever "he/she deems appropriate," and (in the case of EPA) would be used solely for processing such applications.

This is a good idea, particularly considering EPA's dwindling budget. It could be improved, however, in two important respects. First, the restricted use of funds should apply to state programs as well as EPA. Second, the Act should provide that the amount of each fee must actually cover the cost of processing any waiver or exemption. If applicants have to pay for the delays and burdens they impose, there will be less incentive for them to press ill-founded applications or simply drag their feet.

D. Administrative Penalties. EPA proposes to amend the Act by adding authority to assess penalties in administrative orders. The maximum penalty would be $5,000 per day for each violation of: most of the Act's requirements; permit conditions under § 402; or § 404 permit conditions imposed by a state. The EPA proposal provides for notice, opportunity for a local hearing, and judicial review. It also sets forth factors to be considered in setting the size of the penalty, including ability to pay and the effect of a penalty on ability to continue in business. The Attorney General could recover any unpaid penalties by bringing an action in U.S. District Court.

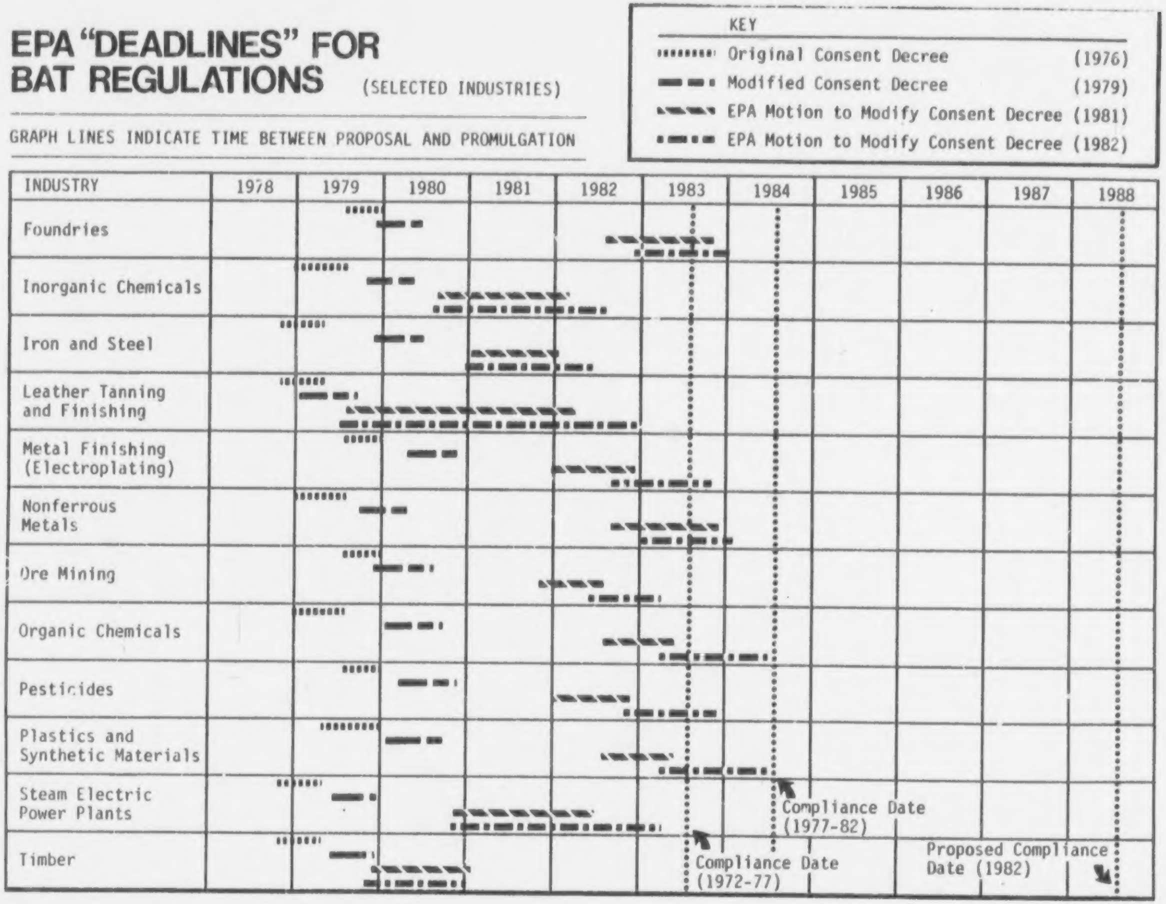
This is an acceptable proposal as long as its ramifications are fully understood. It should not, for example, affect the rights of states or citizens to bring enforcement actions against polluters. It should not be turned into a routine wrist-slapping exercise for violations that should result in civil enforcement suits by EPA. And it should not be carried out in such a way that EPA enforcement resources are frittered away on trivial violations through endless administrative hearings and appeals. These concerns should be considered carefully by Congress.

E. Felony Sanctions. EPA proposes to add new felony sanctions to the law. Presently, the Act authorizes felony sanctions only for repeat offenders. This is a major deficiency in the statute. For example, dumping a toxic substance on the ground could bring felony sanctions under RCRA. But if the same substance is poured into a sewer together with domestic wastes (as happened in Louisville), and causes the same consequences, the Clean Water Act affords only misdemeanor penalties.

EPA proposes to add felony sanctions for negligent and knowing violations of the Act or permit conditions, incuding all of the Act's direct discharge requirements, sludge guidelines, pretreatment restrictions and § 404 permits. The proposal specifically covers a person who "discharges into a sewer system or into a publicliy owned treatment works any pollutant or hazardous substance which may cause the injury of person." The penalties are $2500 to $25,000 and/or one year in prison for negligence, and $5,000 to $50,000 and/or up to two years of imprisonment for knowing violations. The proposal also creates felony sanctions for falsification of reports and tampering with monitoring devices. Repeat offenders could be subject to double these penalties.

EPA "DEADLINES" FOR BAT REGULATIONS (SELECTED INDUSTRIES)

GRAPH LINES INDICATE TIME BETWEEN PROPOSAL AND PROMULGATION



CMA/EPA FIVE-PLANT STUDY

Prepared for
CMA
CHEMICAL MANUFACTURERS ASSOCIATION

by

Engineering-Science, Inc.
3109 North Interregional
Austin, Texas 78722

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ABSTRACT

A study was conducted by Engineering-Science, Inc. (ES) for the Chemical Manufacturers Association (CMA) to analyze the data base developed by a cooperative study among CMA, the U.S. Environmental Protection Agency (EPA), and five organic chemical plants that participated in this project. The study was structured to develop a long-term (4-6 weeks) data base on the removal of toxic organics by representative, well-designed and operated biological treatment plants within the organic chemicals industry. An extensive quality control/quality assurance program was incorporated into this effort to assure that the reliability of the analytical results could be properly defined.

Based upon the study results, the following major conclusions were drawn:

- Data collected during the five-plant study indicate that toxic organic pollutants in all groups (volatiles, base/neutral, and acid) are removed, with few exceptions, to or below the 10 parts per billion detection limit accepted in this study. Thus, one can conclude that biological wastewater treatment facilities installed to meet BPT provide sufficient removal of most toxic organic pollutants to be designated as BAT technology consistent with the Clean Water Act of 1977.
- Analytical method precision and accuracy as measured by intralaboratory repeatability, interlaboratory reproducibility and recovery of known spikes remain as the dominant limiting factor controlling the use of toxic organic pollutant data. For example, for a single laboratory, if a volatile organic pollutant were measured in a single sample as 100 ppb, a second analysis of that same sample could yield a result as low as 20 ppb or as high as 500 ppb.
- Analysis of the study results provides strong confirmation that conventional and nonconventional pollutants cannot be used as indicators of the presence of toxic organic pollutants in biologically treated effluents from the organic chemicals industry.

CHAPTER 1

EXECUTIVE SUMMARY

This report presents the results of a study conducted by Engineering-Science, Inc. (ES) for the Chemical Manufacturers Association (CMA) to analyze the data base developed by a cooperative study among CMA, the U.S. Environmental Protection Agency (EPA), and five chemical plants that participated in the study (hereinafter referred to as the five-plant study). The three primary study objectives were to:

(1) assess the effectiveness of biological wastewater treatment for the removal of toxic organic pollutants;

(2) define the accuracy, precision, and reproducibility of the analytical methods used for measuring toxic organic pollutants in organic chemicals industry wastewaters; and

(3) ascertain if there is a correlation between biological removal of toxic organic pollutants and conventional and nonconventional pollutants.

The five-plant study was structured to develop a long-term data base on the removal of toxic organics by biological treatment systems. An extensive quality control/quality assurance program was included to assure that the reliability of the analytical results could be defined so that proper interpretation of the data base could be made.

All five participating organic chemicals manufacturing plants had well-designed and operated activated sludge treatment systems. These manufacturing sites and their respective treatment systems are a representative sample from the organic chemicals industry. EPA nominated the five participants based upon the expected occurrences of specific toxic organic pollutants.

From 24 to 30 sets of influent and effluent samples were collected at each plant over a four- to six-week sampling period. EPA, through the use of contract laboratories, analyzed all of the samples. A CMA contractor analyzed approximately 25 percent, and four of the participating plants analyzed from 25 to 100 percent of the samples. All samples were analyzed using gas chromatography/mass spectrometry (GC/MS) or gas chromatography (GC) procedures (44 FR 69464 et. seq. December 3, 1979) or variations acceptable to EPA's Effluent Guidelines Division. Each plant also analyzed the influent and effluent samples for selected conventional and nonconventional pollutants during the study periods.

A total of 60 toxic organic pollutants were reported in influent and/or effluent wastewaters. These included all of the 35 that EPA found present at 20 percent or more of the 83 plants surveyed during their screening phase sampling of the organic chemicals/plastics and synthetics industries in 1978.

The main conclusions than can be drawn from this study are described in the following sections.

ANALYTICAL METHODS

- Analytical method precision and accuracy, as measured by intralaboratory repeatability, interlaboratory reproducibility, and recovery of known spikes, remain as tne dominant limiting factor controlling the use of toxic organic pollutant data.
- Significant intralaboratory and interlaboratory uncertainty was observed, although the analytical methods used represent state of the art. The extensiveness of the data base moderates but does not eliminate the inherent analytical uncertainty associated with measuring toxic organic pollutants in wastewater samples.
- There has been a 50 percent decrease in interlaboratory analytical uncertainty since the original EPA screening phase data collection effort for the organic chemicals industry in 1978. There is still, however, a significant probability that, for the same sample, one laboratory will detect a toxic organic pollutant and a second laboratory will not.
- The accuracy of the analytical methods (as determined by recovery of fortified samples, surrogate compounds, and internal standards) was generally poor and highly variable. The

results do not support EPA's method of recovery correction to improve analytical reliability of these methods.

- The reproducibility of the analytical methods limits their use in regulations. If a volatile organic pollutant were measured in a single analysis as 100 ppb, a second analysis of that same sample could yield a result as low as 20 ppb or as high as 500 ppb.
- In spite of inherently high analytical uncertainty, the methods for measuring toxic organic pollutants can be satisfactorily utilized to gather sufficient data on many samples to make observations about specific organic pollutant removal in biological treatment systems.

BIOLOGICAL TREATMENT PERFORMANCE

- The removal of conventional and nonconventional pollutants by the five activated sludge treatment systems during the study period was excellent. The removal of BOD_5 for four of the plants was 97-99 percent and was 71 percent for the fifth plant (this relatively low percent BOD_5 removal is directly related to the extremely low influent BOD_5 levels at this plant; less than 50 mg/l). This performance demonstrated by the five-plant study participants places these plants in the upper 50 percent performers in the data base EPA is using to establish effluent limitations guidelines consistent with BPT and BCT for the organic chemicals and plastics and synthetics industries.
- Toxic organic pollutants in all groups (volatiles, base/neutrals, and acids) are removed also, with few exceptions, to effluent concentrations very close to or below the detection limit (10 ppb) which was accepted in this study for the analytical methodologies utilized. For example, the following indicates the distribution of average effluent (geometric means) concentrations for the 52 individual toxic organic pollutants reported:

Average Effluent Concentration	Number of Pollutants
≤ 10 ppb	36
>10 ppb - 50 ppb	10
>50 ppb -100 ppb	5
>100 ppb	1
Total	52

- For the broad categories within toxic organic pollutants, the overall average removals (based upon geometric means of influent and effluent data) were as follows:

Toxic Organics	Percent Removal
Volatiles	95
Base/Neutrals	87
Acids	77

- Based upon the foregoing information, the biological wastewater treatment facilities installed to meet BPT provide sufficient removal of most toxic organic pollutants to be designated as BAT technology consistent with the Clean Water Act of 1977.
- The "EPA variability factor" which should be used to compute effluent limitations guidelines for toxic organic pollutants on a short-term basis must be substantially higher than 10 times the arithmetic mean concentration.

INDICATOR POLLUTANTS

- Study results show that conventional or nonconventional pollutants cannot be used as indicators of the presence of toxic organic pollutants in biologically treated effluents from the chemicals manufacturing industry. No statistically reliable correlations were found between conventional and nonconventional pollutants and toxic organic pollutants.

The five-plant study data indicate that it may be possible to utilize selected toxic organic pollutants as indicators of the removal of other toxic organic pollutants with similar biotreatment properties within the same pollutant group. Due to analytical uncertainty and plant-specific factors, however, this concept has limited general applicability.

CHAPTER 2

INTRODUCTION

This report presents the results of a study conducted by Engineering-Science, Inc. (ES) for the Chemical Manufacturers Association (CMA) to analyze the data base developed by a cooperative study between CMA, the U.S. Environmental Protection Agency (EPA), and five chemical plants that participated in the study. This study, referred to as the five-plant study, was designed and implemented to evaluate the effectiveness of biological treatment in removing toxic organic pollutants from chemical industry wastewaters. A detailed description of the data base, the analyses conducted, and the conclusions and recommendations developed by ES as a result of these evaluations are presented in this report.

OVERVIEW

The Clean Water Act of 1977 requires that EPA implement effluent limitations guidelines consistent with best available technology economically achievable (BAT) for selected toxic and nonconventional pollutants by July 1, 1984, for a group of specified industrial point-source categories. The organic chemicals and plastics and synthetics industries are specific point-source categories for which effluent limitations guidelines consistent with BAT are to be promulgated. In order to implement this program, EPA has collected samples of both raw wastewaters and treated effluents from a number of organic chemicals and plastics and synthetics plants and tested these for the presence of selected toxic pollutants as well as conventional and nonconventional pollutants. These data collection efforts were performed by EPA in two phases. The first phase was the "screening phase" in which a large number of plants were sampled to define the frequency of occurrence of the toxic pollutants in raw wastewaters and treated effluents from the industry. The objective of the second or "verification phase" was to provide additional information on the treatability of toxic pollutants and their concentrations in raw wastewaters and treated effluents. Evaluation of the data collected during these two phases from the organic chemicals and plastics and synthetics industries plants indicated that: (1) there was considerable analytical uncertainty in the test procedures used; and (2) there was a strong inference that biological treatment effectively removed most toxic pollutants. Data collected by EPA in other industrial point-source categories such as petroleum refining and synthetic rubber support the conclusion that biological treatment designed and operated to meet EPA's definition of best practicable control technology currently available (BPT) provides effective control for most toxic pollutants. Assuming that this conclusion can be verified, this will allow EPA to set BAT effluent limitations guidelines at the BPT level for many of the treated effluents from plants in the organic chemicals and plastics and synthetics industries.

A major difficulty in testing this conclusion with the previously available data base was the fact that the samples collected during the screening and verification phases represented a maximum of three days of operation of each of the plants and treatment systems studied. The long-term efficiency of toxic pollutant reduction by these treatment systems and the variation in effluent concentration of toxic pollutants could not be established adequately using available data. In light of the known analytical uncertainty associated with the tests for the toxic pollutants, particularly the toxic organic pollutants, and the short-term nature of the toxic pollutant data for the organic chemicals and plastics and synthetics industries as well as other industries whose effluents may contain toxic pollutants, a high degree of uncertainty exists in the predictions of treatment system performance. In order to reduce this uncertainty, EPA and the CMA agreed to conduct a cooperative monitoring study at a limited number of chemical plants to supplement the existing short-term data which indicated that biological treatment designed and operated to meet BPT is adequately treating most toxic pollutants.

The resulting cooperative effluent monitoring agreement, which is the subject of this report, involved collection and analysis of samples at each of the participating plants by EPA contractors, a CMA contract laboratory, and the participants. The study was structured to develop a long-term data base on the removal of toxic pollutants by biological treatment with specific attention given to selection of participating plants to provide a wide coverage of toxic pollutants and treatment systems which met the definition of BPT. An extensive quality control/quality assurance program also was implemented by CMA and the participating companies in order to assure that the data base represented the best application of the analytical techniques used. The resulting long-term data base for each of the five participants was analyzed statistically by ES, as a contractor to the CMA, and the results are presented in this report.

OBJECTIVES

The primary objective of the five-plant study is to define the effectiveness of biological waste treatment for the removal of toxic organic pollutants from chemical industry wastewaters. Data obtained to date by EPA, CMA, and other investigators have strongly suggested that biological treatment provides adequate treatment for most toxic organic pollutants. Additional data were needed, however, to demonstrate the effectiveness of biological treatment for removal of toxic organic pollutants over an extended time period and to allow estimation of the variation in treatment system performance in removing these pollutants. The five-plant study was developed to fill this data gap by collecting data from properly operated biological treatment systems over a continuous four- to six-week period.

The second objective of the study was to define the accuracy, repeatability, and reproducibility of the analytical methods used in developing the data base. Evaluation of the analytical methodologies used by EPA for the toxic organic pollutants during the screening and verification phases indicated that these test methods generated highly imprecise quantitative data. Since establishment of numerical effluent limitations guidelines relies entirely on the ability to quantitate the presence of the pollutants of concern, the accuracy, repeatability, and reproducibility of the test procedures used to define the guidelines and assess compliance on a particular treated effluent must be thoroughly understood. The five-plant study program was specifically designed to assure that the reliability of the analytical results could be defined so that proper interpretation of the data base could be made.

The third objective of the five-plant study was to define the degree of correlation and variability between removal of toxic organic, conventional, and nonconventional pollutants by the biological treatment systems evaluated. The use of conventional and nonconventional pollutants as "indicators" of toxic pollutant removal has been suggested by EPA. Data collected to date for the treatment of wastewaters from the organic chemicals and plastics and synthetics industries have shown no correlation between conventional and nonconventional pollutant removal in biological treatment systems and the concurrent removal of the toxic organic pollutants. During the long-term study of the five participant's treatment systems, such correlations in performance between removal of types of pollutants should be observable if they occur.

SCOPE

Five chemical manufacturing companies agreed to participate in the cooperative CMA/EPA study. Participation consisted of agreeing to allow influent and effluent samples to be collected at the biological treatment systems used by each of the five plants. The five participants were nominated by EPA based upon the expected occurrence of specific toxic organic pollutants. The only toxic pollutants included in this study were selected organics. Pesticides, polychlorinated biphenyls, metals, and cyanides were not measured. Individual agreements were reached between the participants and EPA to allow collection of the samples. Typically, from 24 to 30 sets of influent and effluent samples were collected during four- to six-week periods. Samples were analyzed for a selected group of toxic organic pollutants specific to each location and for specified conventional and nonconventional pollutants. Not all toxic organic pollutants included in this study were analyzed at all locations. This fact must be understood when reviewing the results of the study. Appendix A to this report includes details of the sampling and analysis conducted at each of the participating plants.

EPA, through the use of contract laboratories, analyzed all influent and effluent samples for toxic organic pollutants using gas chromatography/mass spectrometry (GC/MS) or gas chromatography (GC) procedures (44 FR 69464 et.seq., December 3, 1979, or variations acceptable to the EPA Effluent Guidelines Division). One EPA laboratory used GC coupled with flame ionization detection (GC/FID). Approximately 25 percent of the influent and effluent samples collected at each participating plant were analyzed by the CMA contractor using GC/MS procedures (44 FR 69464 et.seq., December 3, 1979, or equivalent). Some variation occurred in the analytical procedures for the toxic organic pollutants used by both the EPA contract laboratories and the CMA laboratory during the course of this study. These procedural variations are summarized in Appendix A.

Each participant provided conventional/nonconventional pollutant analyses of their influent and effluent wastewaters using the methods found in "Methods for Chemical Analysis of Water and Wastes," EPA 600/4-79-020, March 1979. Additionally, four of the participants analyzed from 25 to 100 percent of the samples collected by EPA for the toxic organic pollutants being evaluated by the Agency. At a minimum, those analyses included duplication of the CMA contractor's analyses.

In this study, data are not adjusted for recoveries since recovery of spikes proved to be variable. One entire set of laboratory data was not included in the scope of this study. This data set was from the EPA contract laboratory for Participant A. The EPA contract laboratory reported interference problems in the analysis of the samples and reported that these data should not be considered valid. The EPA contract laboratory then froze the remaining portions of the samples intending to rerun the analysis after the interferences were resolved. The time between the sample collection period (May-July 1981) and the initiation of the second set of analyses (December 1981) was so long as to jeopardize the integrity of the samples based on EPA recommendations (44 FR 75051, December 18, 1979).

Excluding pesticides, polychlorinated biphenyls, metals, cyanides, and dioxin, there are 85 toxic organic pollutants on EPA's list of priority pollutants. At the time the five-plant study was initiated, there were 88 pollutants; EPA has since deleted dichlorodifluoromethane, trichlorofluoromethane (46 FR 2266) and bis(chloromethyl) ether (46 FR 10723) from the list of priority pollutants. Sixty toxic organic pollutants including one of the delisted pollutants, trichlorofluoromethane, were reported in the wastewaters sampled during the five-plant study. Table 2.1 shows the frequency distribution of toxic organic pollutants reported in the wastewaters of the five participants. A total of 58 different toxic organic pollutants were reported in the biological treatment system influents while 52 pollutants were reported in the effluents. There were no pollutants which were reported in the wastewaters (influent or effluent) of all five participants. Since

TABLE 2.1

FREQUENCY DISTRIBUTION OF TOXIC ORGANIC POLLUTANTS REPORTED IN WASTEWATERS OF THE FIVE PARTICIPANTS

Number of Participants For which Pollutant was Reported	Percent of Total Number of Pollutants Reported	Toxic Organic Pollutant Group		
		Volatile	Base/Neutral	Acid
1	37	Acrylonitrile Bromomethane Carbon tetrachloride Chloroethane Dibromochloromethane 1,1-dichloroethane 1,2-dichloropropane 1,3-dichloropropene 1,1,2,2-tetrachloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane Trichlorofluoromethane Vinyl chloride	Acenaphthene Chrysene Dibenzo(a,h)anthracene 1,3-dichlorobenzene[1] (1,4-dichlorobenzene)[1] Dioctylphthalate Fluorene Isophorone	4-chloro 3 methylpheno
2	49	Bromodichloromethane Chlorobenzene 1,2-dichloroethane 1,1-dichloroethene t-1,2-dichloroethene Tetrachloroethene Trichloroethene	Acenaphthylene* Anthracene[2] (Phenanthrene)[2] Benzo(a)anthracene[3] (Chrysene)[3] Benzo(b)fluoranthene[4] (Benzo(k)fluoranthene)[4] Benzo(a)pyrene Bis(2-ethylhexyl)phthalate Butylbenzylphthalate* Di-n-butylphthalate 1,2-dichlorobenzene Diethylphthalate* Dimethylphthalate Fluoranthene Naphthalene Nitrobenzene Pyrene 1,2,4-trichlorobenzene*	2,4-dichlorophenol 2,4-dimethylphenol 2,4-dinitrophenol 2-nitrophenol 2,4,6-trichlorophenol
3	10.5	Chloroform Ethylbenzene Methylene chloride Toluene	---	2-chlorophenol Pentachlorophenol
4	3.5	Benzene	---	Phenol

[1,2,3,4] Laboratory analysis reported for both compounds as single (indistinguishable) isomer pair.

*Note: There was some question in the proper identification of these compounds in some of the samples, based on the following information:

(1) 1,2,4-trichlorobenzene – most likely the co-isomer, 2,4,6-trichlorobenzene, which is not on the priority pollutant list.
(2) Diethylphthalate – interference with dimethyl nitroaniline which coelutes with the phthalate ester.
(3) Acenaphthylene – interference with dichloroaniline or biphenyl which coelutes with acenaphthylene.
(4) Butylbenzylphthalate – most likely a product from a manufacturing process and not the phthalate ester.

some wastewaters were analyzed only for one pollutant group, it is impossible for any pollutant to be reported in the wastewaters from all five participants.

Table 2.2 lists toxic organic pollutants found by EPA in 20 percent or more of the 83 plants sampled during their screening phase survey of the organic chemicals and plastics and synthetics industries. The pollutants are arranged in this table according to the frequency of their observation during the screening phase. Also shown in Table 2.2 is the coverage of these pollutants by the sampling done during the five-plant study. As can be seen, the five-plant study included all 35 of the toxic organic pollutants found at 20 percent or more of the plants surveyed during EPA's screening phase. These two tables indicate that excellent coverage of toxic organic pollutants expected to be present in chemical industry effluents was achieved in this long-term study.

All five participating plants can be described as organic chemicals manufacturing facilities. No plants manufacturing only plastics and synthetic materials are included in this survey, although some of the participants may have one or more plastics and synthetics products/processes contributing wastewater to the treatment system.

All of the data for the toxic organic pollutants, conventional and nonconventional pollutants, and treatment system characteristics were received by ES directly from the participants. Each participant also provided descriptive information indicating any qualifying characteristics of the data base and any important characteristics of the treatment system or wastewaters at the participating plant. Upon receipt by ES, these data were assigned a code number to preserve confidentiality and then transferred to a machine-processible format. The data were then entered into ES's central computer system for manipulation and analysis. Wherever practical, all statistical analyses and data management were done on the digital computer. Appendix B describes the data management and analysis techniques used by ES for the five-plant study.

The EPA used three different contract laboratories to perform the toxic organic pollutant analyses for the five-plant study. Three of the participants used their own laboratories, while a fourth participant used a contract

TABLE 2.2

TOXIC ORGANIC POLLUTANT FREQUENCY DISTRIBUTION OF EPA SCREENING PHASE DATA AND COVERAGE BY CMA/EPA FIVE-PLANT STUDY

Frequency Group		
I Greater Than 50 Percent of Plants	II 30-50 Percent of Plants	III 20-30 Percent of Plants
Volatile	Volatile	Volatile
Benzene	Acrylonitrile	Dibromochloromethane
Carbon tetrachloride	Bromodichloromethane	1,2-dichloropropane
Chloroform	Chlorobenzene	1,1,2,2-tetrachloroethane
Ethylbenzene	1,2-dichloroethane	Base/Neutral
Methylene chloride	1,1-dichloroethene	Acenaphthene
Tetrachloroethene	Trans-1,2-dichloroethene	Anthracene
Trichloroethene	1,1,1-trichloroethane	Dimethylphthalate
Toluene	Trichlorofluoromethane	Fluorene
Base/Neutral	Base/Neutral	Pyrene
Bis(2-ethylhexyl)phthalate	Butylbenzylphthalate	Acid
Di-n-butylphthalate	Diethylphthalate	2-chlorophenol
Acid	Naphthalene	2,4,6-trichlorophenol
Phenol	Phenanthrene	
	Acid	
	2,4-dimethylphenol	
	Pentachlorophenol	
Total Number of Pollutants:		
11	14	10
Percent Coverage in CMA/EPA Five-Plant Study:		
100	100	100

NOTE: EPA Screening Phase data (handout to CMA - May 4, 1979): 83 plants, 984 samples.

laboratory to analyze the participant's samples for toxic organic pollutants during the course of the survey. The CMA laboratory remained the same throughout the entire study. In total, eight different laboratories participated in the five-plant study. The conventional/nonconventional pollutant data were provided by each of the participants and generally were those pollutants included as part of the discharge monitoring requirements of their NPDES Permits.

DEFINITIONS AND TERMINOLOGY

Prior to proceeding with detailed discussions of the study and its results, it is important to identify and define the terms which will be used in this report. The term "toxic organic pollutant," as used herein, refers to the specific organic pollutants on the list of toxic pollutants (including the three pollutants now delisted) identified in Section 307(a)(1) of the Clean Water Act of 1977. These pollutants are those which also have been referred to as "priority pollutants" by EPA.

The terms "participant" and "participating plant" refer to the organic chemicals plants participating in this survey and the associated wastewater treatment systems at these facilities. In order to preserve the anonymity of the participants, the five participants are referred to as Participants A, B, C, D, and E throughout this report. The term "biological treatment system" is used to describe the entire biological treatment unit including the aeration basin or basins, the associated clarifiers, and biological solids recycle systems. It does not include any pretreatment system other than neutralization and/or clarification nor any effluent polishing devices following the clarifiers. The terms "conventional and nonconventional pollutants" are used as defined in the Clean Water Act of 1977. The conventional pollutants used in this study are five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS). The nonconventional pollutants include total organic carbon (TOC), chemical oxygen demand (COD), and total oxygen demand (TOD). The test procedures for the conventional and nonconventional pollutants are those defined at 40 CFR, Part 136.

The terms "BPT," "BCT," and "BAT" stand for best practicable control currently available, best conventional pollutant control technology, and best available technology economically achievable, respectively. These represent required levels of effluent control technology for industrial point sources as defined in Section 301(b) of the Clean Water Act.

The laboratories which performed the analyses of the wastewater samples in the five-plant study have been grouped for comparative purposes into three types or categories. They are: (1) company or company-contract, referred to as Lab 1 in this report; (2) CMA-contract, Lab 2; and (3) EPA-contract, Lab 3.

Concentrations of the toxic organic pollutants are reported as "parts per billion" (ppb) for convenience. It must be recognized that all concentrations were actually measured and reported as micrograms per liter ($\mu g/l$), which are not exactly equivalent to ppb by weight in aqueous solutions, except under certain conditions. As used in this report, ppb and $\mu g/l$ are synonomous.

The term "EPA variability factor" (V_{EPA}), as used herein is the ratio between a pollutant concentration which is exceeded only one percent of the time (99 percent probability level) and the long-term arithmetic mean concentration of that pollutant in the wastewater. It is the variability factor defined by EPA in the recent Contractors Report on the Organic Chemicals Industry (Ref. 2.1).

Four distinctly separate measures of analytical precision or analytical uncertainty were used in this study: (1) "Analytical Repeatability Factors," (2) "Range of Duplicate Factors (within laboratory, 95 percent confidence level)," (3) "Analytical Reproducibility Factors," and (4) "Range of Duplicate Factors (between laboratories, 95 percent confidence level)."

"Analytical Repeatability Factors" (W_U, W_L) define, with respect to a single laboratory, the 95 percent confidence limits (upper limit W_U, lower limit W_L) for a single value. "Analytical Reproducibility Factors" (V_U, V_L) define, with respect to more than one laboratory, the 95 percent confidence limits (upper limit V_U, lower limit V_L) for a single value. For example, assume that an effluent sample is analyzed by a specified method which has been shown to have, for a particular pollutant, an intralaboratory precision (pooled standard deviation) of 0.187. The value found for the pollutant was 100 ppb. Based on this precision estimate, the upper and lower analytical repeatability factors are $W_U=1.44(\exp(1.96*0.187))$ and $W_L=0.69(\exp(-1.96*0.187))$. If the analysis of this exact sample were repeated in the same laboratory 100 times, 95 percent of the values would fall between 69 ppb (0.69x100 ppb) and 144 ppb (1.44x100 ppb).

Assume, for example, that the same sample is analyzed once in a particular laboratory by the same specified method which has been shown to have, for the same particular pollutant, an interlaboratory precision (pooled standard deviation) of 0.880. Again, the value found was 100 ppb. Based on this interlaboratory (between laboratories) precision estimate, the upper and lower analytical reproducibility factors are $V_U=5.61(exp(1.96*0.880))$ and $V_L=0.18(exp(-1.96*0.880)$. If the analysis of this exact sample were repeated once in each of 100 laboratories, 95 percent of the values found would fall between 18 ppb (0.18x100 ppb) and 561 ppb (5.61x100 ppb).

The other two measures of analytical precision used in this study, Range of Duplicates Factors (intralaboratory, 95 percent confidence level) and Range of Duplicates Factors (interlaboratory, 95 percent confidence level) provide yardsticks against which to measure whether two single analyses for a particular pollutant on a single sample agree as well as can be expected, based on previously established measures of analytical precision. Range of Duplicates Factors (intralaboratory, 95 percent confidence level) (P_U, P_L) are used in this study to define the range of values into which a second determination, made in the same laboratory, is expected to fall. For example, if the intralaboratory precision has been estimated to be 0.187 (pooled standard deviation), P_U and P_L are then $1.68(exp(\sqrt{2}*1.96*0.187))$ and $0.60(exp(-\sqrt{2}*1.96*0.187))$, respectively. If a single value in that one laboratory is 100 ppb, a second value should, 95 percent of the time, fall within 60 ppb (0.60x100 ppb) to 168 ppb (1.68x100 ppb). If it falls outside this range, the method may not be under statistical control in that laboratory.

Range of Duplicates Factors (interlaboratory, 95 percent confidence level) (R_U and R_L) are used in this study to define the range of values into which a second determination, measured in a laboratory other than the laboratory in which the first determination was made, is expected to fall. For example, if the interlaboratory precision has been estimated to be 0.880 (pooled standard deviation), R_L and R_U are then $0.09(exp(-\sqrt{2}*1.96*0.880))$ and $11.46(exp(\sqrt{2}*1.96*0.880))$, respectively. If a single value in one laboratory is 100 ppb, a second value in any other laboratory should fall between 9 ppb and 1,146 ppb. If it falls outside this range, the method may not be under statistical control in one or both laboratories.

It must be noted that V_U and V_L are not related to the variability calculated by the EPA method and designated as V_{EPA}. V_{EPA} is defined as the ratio of the 99th percentile concentration based on the log normal distribution to the arithmetic mean concentration of a series of separate samples. V_U and V_L refer specifically to the interlaboratory uncertainty with respect to more than one laboratory of a single value obtained on a single sample. V_{EPA} includes the uncertainty due to analytical repeatability defined by W_U and W_L superimposed on the variability in concentration among a series of different samples. It also includes the variability in influent wastewater loadings and treatment system performance.

TEST CASE DESCRIPTIONS

As the name of the study implies, there are five participants which cooperated in developing the data base used in this evaluation. All five of the participating plants utilize activated sludge biological treatment systems. Table 2.3 summarizes operating characteristics of each of the five participants' biological treatment systems. As can be seen from reviewing this table, there is a relatively wide range of system operating parameters such as mixed liquor suspended solids (MLSS) and hydraulic retention time represented by the participants in the five-plant study. The operating temperatures of the participants' biological treatment systems during the data collection phases of the five-plant study ranged from 15 to 33°C. None of the sampling was performed during the winter months.

Based on ES's experience, the activated sludge plants operated by the participants are typical of those used for wastewater treatment in the organic chemical industry. Hydraulic retention times for activated sludge units treating wastewaters from organic chemicals manufature typically are longer than one day and may be considerably longer if the wastewater is considered to contain organics which are slowly biodegradable. Likewise, the reported range of MLSS concentrations is typical of plants in this industry since it is often necessary to operate at high concentrations of MLSS in order to reduce organic loadings to levels acceptable for biological treatment.

TABLE 2.3

WASTEWATER TREATMENT SYSTEMS
AVERAGE OPERATING PARAMETERS

Operating Parameter	Participant				
	A	B	C	D	E
Treatment System Type	Activated Sludge	Activated Sludge	Activated Sludge	Activated Sludge	Activated Sludge
Hydraulic Retention Time (days)	2.9(36)	1.0(*)	2.3(40)	3.4(54)	NA
MLSS (mg/l)	9,390(36)^n 9,440(21)^s	5,120(23)	3,100(83)**	2,980(54)	NA
Temperature (°C)	18(36)^n 15(21)^s	25(23)	33(22)	26(54)	NA
Study Period	5/11/81 to 7/1/81	10/10/80 to 11/11/80	6/02/80 to 7/10/80	6/16/80 to 8/08/80	4/12/81 to 5/17/81

*Estimate.

**MLVSS.

n - north aeration basin.

s - south aeration basin.

NA - not available.

(N) is the number of measurements during study period.

The time frame during which the study was conducted at each participant's plant also is shown in Table 2.3. In general, the duration of the surveys was from four to six weeks at each plant and the samples were collected four to six times weekly, as applicable. The details of the sampling schedule are summarized in Appendix A of this report.

REFERENCES

2.1 Walk, Haydel and Associates, Inc., "Contractors Engineering Report, Analysis of Organic Chemicals and Plastics and Synthetic Resins Industries — Conventional and Nonconventional Pollutant Parameters," U.S. EPA, Effluent Guidelines Division, Washington, D.C., October 30, 1981.

CHAPTER 3
EVALUATION OF TOXIC POLLUTANT ANALYTICAL CAPABILITY

In 1976, EPA began to develop effluent limitations guidelines for toxic organic pollutants in industrial effluents. These efforts have been constrained by the lack of reliability of the analytical methods used to identify and quantify these pollutants in both untreated wastewaters and treated effluents. During EPA's screening phase and verification phase data collection efforts, it was learned that there was considerable uncertainty in the measurements of the trace quantities of the toxic organic pollutants in industrial wastewaters, including those of the organic chemicals and plastics and synthetics industries. These data were analyzed by CMA and the qualitative and quantitative variability present in EPA's toxic pollutant data base for the chemicals industry raised serious questions about the appropriate use of this data base for developing effluent limitations guidelines.

One of the primary objectives of the five-plant study was to characterize accuracy, repeatability, and reproducibility of the analytical methodology used in the development of the treatability data base for the toxic organic pollutants. This thorough knowledge of analytical uncertainty is an absolute prerequisite to the use of the data gathered from the five-plant study for the purposes of documenting the biological treatability and effluent concentrations of the toxic organic pollutants in organic chemicals industry wastewaters. This chapter presents the results of this extensive quality assurance/quality control program and establishes the level of reliability of the analytical data resulting from the five-plant study.

Before proceeding with the discussion of the evaluation of the analytical methodology, it is necessary to define the terms which are used to assess this reliability. The term "accuracy" represents the ability of a test procedure to measure the "true" concentration of a specific pollutant in a given sample matrix. Accuracy can be measured only on a sample in which the true concentration is known. Accuracy is evaluated in this study by the recoveries of known spike concentrations of toxic organic pollutants in fortified (spiked) samples, as well as the recoveries of surrogate compounds and internal standards used in the analyses. The "precision" of an analytical method is a measure of how well a test method will perform on multiple analyses of the same sample; that is, how closely multiple measurements taken from the same sample will agree. A simple analogy for comparing accuracy and precision can be made using the game of darts; accuracy would represent how close the darts struck to the bull's-eye, precision would be how closely the darts were grouped to one another. Obviously, a method could have a high level of precision but poor accuracy.

Both intralaboratory (within laboratory) and interlaboratory (between laboratories) precision were evaluated in this study. Intralaboratory precision, repeatability, refers to the analytical uncertainty generated using the same test procedure within a single laboratory. Interlaboratory precision, reproducibility, refers to the analytical uncertainty generated by analyzing the same sample in different laboratories using the same analytical methodology. Both types of variability are important. Intralaboratory precision is significant in determining how well a single laboratory may perform in analyzing effluent samples to compare with specified permit limitations for a particular toxic organic pollutant. Interlaboratory precision is relevant where the EPA uses a data base developed with a number of different laboratories testing a large number of treatment systems.

Appendix B to this report, entitled "Data Management," describes in detail the statistical analyses used to determine the reliability of the analytical data, as reported in this chapter. In addition, it discusses certain assumptions that had to be made to permit these statistical analyses to be performed. These detailed discussions will not be repeated here.

INTRALABORATORY PRECISION

Intralaboratory precision was calculated for individual toxic organic pollutants and for each of the pollutant groups as a whole. Calculations were based on the assumption of the log normal distribution of concentrations from replicate analyses. The assumption that the log normal distribution describes the treatment system influent and effluent concentration data is both a matter of convenience and a result of considerable documentation by EPA, and others, that it generally describes the probability distributions of such data. This occurs since wastewater concentration data are bounded at the lower end by zero (particularly effluent data) but have, in effect, an almost unlimited upper bound. Thus, typically, there are a few very high concentrations in a particular data set which skew the probability distribution to the extent that log normal statistics describe the concentration data better than, or at least as well as, Gaussian normal statistics.

A second assumption which was made was that the data bases for a given toxic organic pollutant from different participating plants could be pooled for statistical analysis. The primary purpose for this pooling of data was to retain confidentiality for each participant. Additionally, the data base for each pollutant in a particular influent and effluent was often very limited in size, and pooling these data often significantly increased the size of the data base for a particular pollutant. It is recognized that the most rigorous statistical approach should include testing these assumptions on each individual data set; because of the considerations described above, ES did not perform these analyses of assumptions on all data sets, but random observations supported the overall validity of the approach taken.

A third assumption was made so that the precision estimate for individual toxic organic pollutants could be pooled to provide an estimate of the precision for a particular pollutant group. Some of the precision estimates for individual pollutants would not meet rigorous statistical criteria which would allow pooling of the data. Many of the pollutants had only a few observations which certainly limited the reliability of the corresponding precision estimate. By pooling the data by pollutant group, however, one significantly increased the data base and reliability of the group as a whole. The pooled precision estimate for each group is useful in that it provides a basis of comparison for individual pollutants in a group as well as comparisons between pollutant groups.

Tables 3.1, 3.2, and 3.3 summarize the intralaboratory precision for the volatile, base/neutral, and acid groups of the toxic organic pollutants, respectively. Included in each of these tables for both influent and effluent samples are the geometric mean concentration, the pooled intralaboratory standard deviation, the upper 95 percent Analytical Repeatability Factor (W_U), the upper Range of Duplicates Factor (P_U) (intralaboratory, 95 percent confidence level) 95 percent, and the number of samples for which replicate analyses were performed and upon which the precision calculations were based. The two corresponding lower factors, W_L and P_L, are not tabulated since they are merely reciprocals of the upper factors ($W_L = 1/W_U$, $P_L = 1/P_U$).

TABLE 3.1

INTRALABORATORY PRECISION FOR VOLATILE TOXIC ORGANIC POLLUTANTS

Pollutant	Geometric Mean (ppb)	Pooled Standard Deviation ($\log_e$ scale)	Upper 95 Percent Repeatability Factor (W_u)	Upper 95 Percent Range of Duplicates Factor (P_u)	Number of Replicate Sets
Influent					
Acrylonitrile	11,700	0.959	6.55	14.25	19
Benzene	310	0.452	2.42	3.50	35
Bromomethane	1,270	0.729	4.17	7.54	6
Bromodichloromethane	13	0.655	3.61	6.15	7
Carbon tetrachloride	160	0.065	1.14	1.20	2
Chlorobenzene	23	0.562	3.01	4.75	10
Chloroethane	19	0.438	2.36	3.37	6
Chloroform	612	0.116	1.26	1.38	16
Dibromochloromethane	5	0.000	1.00*	1.00*	6
1,1-dichloroethane	13	0.417	2.27	3.18	7
1,2-dichloroethane	541	0.187	1.44	1.68	22
1,1-dichloroethene	29	1.925	43.55	207.74	21
t-1,2-dichloroethene	65	0.655	3.61	6.14	4
1,2-dichloropropane	119	0.232	1.58	1.90	14
1,3-dichloropropene	142	0.151	1.34	1.52	11
Ethylbenzene	272	0.293	1.78	2.25	35
Methylene chloride	20	1.629	24.38	91.47	18
Tetrachloroethene	5	0.687	3.84	6.71	11
1,1,1-trichloroethane	7	0.146	1.33	1.50	9
1,1,2-trichloroethane	5	0.718	4.09	7.32	5
Trichloroethene	8	0.624	3.40	5.63	8
Toluene	5,170	0.233	1.58	1.91	32
Vinyl chloride	5	0.000	1.00*	1.00*	1
All Volatile Pollutants	150	0.772	4.55	8.51	305
Effluent					
Acrylonitrile	11	2.432	117.62	846.60	3
Benzene	6	0.513	2.73	4.14	19
Bromodichloromethane	3	0.805	4.85	9.31	4
Chloroethane	5	0.000	1.00*	1.00*	1
Chloroform	16	0.105	1.23	1.14	18
1,1-dichloroethane	5	0.000	1.00*	1.00*	1
1,2-dichloroethane	9	0.284	1.74	2.19	21
t-1,2-dichloroethene	5	0.000	1.00*	1.00*	2
1,2-dichloropropane	7	0.037	1.08	1.11	9
1,3-dichloropropene	3	0.697	3.92	6.91	7
Ethylbenzene	3	0.882	5.63	11.52	5
Methylene chloride	8	0.463	2.48	3.61	15
1,1,2,2-tetrachloroethane	3	0.929	6.18	13.13	1
Tetrachloroethene	3	0.805	4.85	9.32	2
1,1,1-trichloroethane	5	0.518	2.76	4.20	6
Trichloroethene	3	0.805	4.84	9.31	6
Trichlorofluoromethane	5	0.000	1.00*	1.00*	1
Toluene	7	0.592	3.19	5.16	20
All Volatile Pollutants	7	0.585	3.15	5.06	141

*All concentrations were below 10 ppb.

TABLE 3.2

INTRALABORATORY PRECISION FOR BASE/NEUTRAL TOXIC ORGANIC POLLUTANTS

Pollutant	Geometric Mean (ppb)	Pooled Standard Deviation ($\log_e$ scale)	Upper 95 Percent Repeatability Factor (W_u)	Upper 95 Percent Range of Duplicates Factor (R_u)	Number of Replicate Sets
Influent					
Acenaphthene	165	0.085	1.18	1.27	3
Acenaphthylene**	115	0.076	1.17	1.24	4
Anthracene^1/Phenanthrene^1	145	0.117	1.26	1.38	4
Benzo(a)anthracene^2/Chrysene^2	62	0.152	1.35	1.52	3
Benzo(b)fluoranthene^3/Benzo(k)fluoranthene^3	29	0.445	2.39	3.43	3
Benzo(a)pyrene	6	2.058	56.52	300.33	3
Bis(2-ethylhexyl)phthalate	126	0.498	2.66	3.98	16
Butylbenzylphthalate**	15	0.977	6.78	14.98	2
Di-n-butylphthalate	54	0.353	2.00	2.66	14
1,3-dichlorobenzene^4/1,4-dichlorobenzene^4	5	0.000	1.00*	1.00*	1
1,2-dichlorobenzene	322	0.093	1.20	1.30	22
Diethylphthalate**	121	0.388	2.14	2.93	12
Dimethylphthalate	37	0.859	5.38	10.80	14
Dioctylphthalate	23	0.212	1.52	1.80	4
Fluoranthene	141	0.123	1.27	1.41	3
Fluorene	125	0.067	1.14	1.20	3
Isophorone	650	0.000	1.00*	1.00*	1
Naphthalene	3,910	0.110	1.24	1.36	3
Nitrobenzene	3,390	0.166	1.39	1.59	13
Pyrene	63	0.109	1.24	1.35	4
1,2,4-trichlorobenzene**	237	0.192	1.46	1.70	23
All Base/Neutral Pollutants	152	0.475	2.54	3.73	155
Effluent					
Acenaphthene	2	1.139	9.31	23.46	2
Acenaphthylene**	2	1.139	9.32	23.47	3
Anthracene^1/Phenanthrene^1	3	0.986	6.91	15.37	4
Benzo(a)anthracene^2/Chrysene^2	6	0.878	5.59	11.40	6
Benzo(b)fluoranthene^3/Benzo(k)fluoranthene^3	8	1.053	7.88	18.52	6
Benzo(a)pyrene	2	1.139	9.32	23.47	3
Bis(2-ethylhexyl)phthalate	15	0.465	2.49	3.62	21
Butylbenzylphthalate**	3	0.805	4.85	9.32	2
Chrysene	2	1.138	9.30	23.43	1
Di-n-butylphthalate	4	0.680	3.80	6.59	14
1,2-dichlorobenzene	18	1.062	8.01	18.96	10
Diethylphthalate**	10	0.250	1.63	2.00	7
Dimethylphthalate	3	0.805	4.84	9.30	6
Dioctylphthalate	5	0.000	1.00*	1.00*	1
Fluoranthene	4	0.570	3.05	4.85	8
Naphthalene	3	0.930	6.18	13.15	6
Nitrobenzene	314	0.027	1.05	1.08	1
Pyrene	4	0.609	3.30	5.40	7
1,2,4-trichlorobenzene**	43	0.468	2.50	3.66	20
All Base/Neutral Pollutants	9	0.742	4.28	7.82	128

^{1,2,3,4}Reported as isomer pairs.

*All concentrations were below 10 ppb.

**Note: There was some question in the proper identification of these compounds in some of the samples, based on the following information:

(1) 1,2,4-trichlorobenzene – most likely the co-isomer, 2,4,6-trichlorobenzene, which is not on the priority pollutant list.
(2) Diethylphthalate – interference with dimethyl nitroaniline which coelutes with the phthalate ester.
(3) Acenaphthylene – interference with dichloroaniline or biphenyl which coelutes with acenaphtylene.
(4) Butylbenzylphthalate – most likely a product from a manufacturing process and not the phthalate ester.

TABLE 3.3

INTRALABORATORY PRECISION OF ACID TOXIC ORGANIC POLLUTANTS

Pollutant	Geometric Mean (ppb)	Pooled Standard Deviation ($\log_e$ scale)	Upper 95 Percent Repeatability Factor (W_u)	Upper 95 Percent Range of Duplicates Factor (P_u)	Number of Replicate Sets
Influent					
2-chlorophenol	60	0.240	1.60	1.95	25
2,4-chlorophenol	422	0.093	1.20	1.30	21
2,4-dimethylphenol	516	0.362	2.03	2.72	5
2,4-dinitrophenol	562	0.712	4.03	7.19	17
2-nitrophenol	41	0.274	1.71	2.14	15
Pentachlorophenol	231	0.142	1.32	1.48	24
Phenol	212	0.239	1.60	1.94	61
2,4,6-trichlorophenol	90	0.417	2.26	3.18	43
All Acid Pollutants	163	0.333	1.92	2.52	211
Effluent					
4-chloro-3-methylphenol	13	0.053	1.11	1.16	1
2-chlorophenol	22	0.619	3.36	5.55	11
2,4-dichlorophenol	30	0.532	2.84	4.37	15
2,4-dimethylphenol	5	0.000	1.00*	1.00*	7
2,4-dinitrophenol	22	2.048	55.34	291.51	4
2-nitrophenol	3	1.757	31.30	130.75	1
Pentachlorophenol	101	0.396	2.17	3.00	29
Phenol	8	0.541	2.89	4.48	31
2,4,6-trichlorophenol	49	0.591	3.19	5.14	35
All Acid Pollutants	29	0.628	3.42	5.70	134

*All concentrations were below 10 ppb.

There are considerably fewer replicate data sets for the effluent than for the influent, reflecting the high degree of removal of the toxic organic pollutants in all groups by the biological treatment systems. This means that the precision estimates for the treated effluents are considerably less reliable than the corresponding values for the influent data. As will be noted in each of the tables, in certain cases the Analytical Repeatability Factor and the Range of Duplicates Factor are equal to 1, which resulted when all measured concentrations for a pollutant were below 10 parts per billion (ppb), and were set equal to 5 ppb. The two intralaboratory precision factors vary greatly on a compound-to-compound basis. In Table 3.4, the pooled intralaboratory precision data from Tables 3.1 through 3.3 for each of the pollutant groups in effluent samples are used to demonstrate first the uncertainty in concentration to which a single value (at either of two arbitrary levels) would be subject, and secondly, the range of concentrations into which a second analysis of the same sample could be expected to fall when the first analysis produced the indicated concentration value.

The uncertainty in a single value is an important consideration since recent EPA publications suggest that an analysis of a sample indicates noncompliance with an established standard when the upper 99 percent confidence limit on the measured value exceeds the figure in a "less than some number" limitation, even though the actual value found is less than the limiting value. The example shown in Table 3.4 is self-explanatory; even within a single laboratory, there is considerable analytical uncertainty in each of the pollutant groups with the analytical uncertainty being the highest in the base/neutral group of pollutants and the lowest in the volatile group.

INTERLABORATORY PRECISION

The analysis of interlaboratory precision included both qualitative and quantitative comparison of the data base from the five-plant study. Qualitative comparison of laboratories refers to the percentage of time that laboratories analyzing the same sample agree on the detection and nondetection of the specific toxic organic pollutants. Wastewater samples from the five plants participating in the study were not analyzed for all toxic organic pollutants. Within the laboratories analyzing samples from a single participant, there were differences in the number of pollutants for which analysis

TABLE 3.4

SUMMARY OF INTRALABORATORY PRECISION FOR TREATED EFFLUENTS

Uncertainty in Concentration Value from a Single Analysis (Based on 95 Percent Probability)			
	Volatile Group	Base/Neutral Group	Acid Group
Single Value Found:			
100 ppb	32-317 ppb	23-428 ppb	29-342 ppb
10 ppb	3-32 ppb	2-43 ppb	3-34 ppb
Range in Concentration for Second Single Value (Based on 95 Percent Probability)			
	Volatile Group	Base/Neutral Group	Acid Group
Given a First Value of:			
100 ppb	20-506 ppb	13-782 ppb	17-570 ppb
10 ppb	2-51 ppb	1-78 ppb	2-57 ppb

was conducted. Therefore, qualitative comparisons for each participant were based only on the pollutants which were common to the laboratories being compared, and this resulted in a rather small data base.

Table 3.5 summarizes the qualitative comparison of laboratories shown as percent agreement and disagreement in detection/nondetection of the toxic organic pollutants. The results of the analyses of the influent samples and effluent samples are shown separately by each toxic organic pollutant group. The number of pollutants and number of samples used in this comparison also are shown. In Appendix C of this report, this qualitative comparison is divided further showing the comparison not only by toxic organic pollutant group in the influent and effluent samples, but also by one laboratory versus another for each participant. As the comparisons in Table 3.5 illustrate, the percent agreement between laboratories was highest when both showed a pollutant as not detected. There is a considerable degree of variability in the results, however, probably caused in part by the relatively small number of samples used in the qualitative comparison. The results of this analysis tend to substantiate the conclusions drawn from earlier studies of this nature (see Chapter 6); that is, there is a relatively high probability that one laboratory will detect a pollutant in a single sample while a second laboratory will not detect that pollutant in the same sample. This is a particularly disturbing characteristic of the analytical methodology for the toxic organic pollutants which does not seem to have been corrected in this data base.

There are several items which should be noted about the method that was used to calculate qualitative percentage agreement among laboratories. Pollutants which could not be quantified because of analytical interferences were counted by ES as detections for the qualitative comparisons. Second, with replicate analyses, if one of the analyses for a particular pollutant was reported as a nondetection and the other was reported as a detection; an arbitrary choice was made that the pollutant was to be considered as detected. In addition, four isomeric pairs in the base/neutral group were reported as single pollutants, thus effectively shortening the base/neutral group pollutant list by four compounds. These assumptions may have tended to decrease the qualitative agreement between laboratories, but ES believes that this approach is the most realistic basis for qualitatively comparing interlaboratory performance.

TABLE 3.5

QUALITATIVE COMPARISON OF LABORATORIES PERCENT AGREEMENT AND DISAGREEMENT IN DETECTION/NONDETECTION OF TOXIC ORGANIC POLLUTANTS

		Influent Samples			Effluent Samples		
		Toxic Organic Pollutant Group			Toxic Organic Pollutant Group		
	Number of Labs	Acid	Base/ Neutral	Volatile	Acid	Base/ Neutral	Volatile
Participant A							
Agree		100%	88%	94%	85%	79%	91%
Detected	2	18%	18%	11%	0%	0%	3%
Nondetected		82%	70%	83%	85%	79%	89%
Disagree		0%	12%	6%	15%	21%	8%
Number of Pollutants		11	44	30	11	44	30
Number of Samples		3	3	3	3	3	3
Participant B							
Agree		86%	NA	NA	83%	NA	NA
Detected	2	60%	NA	NA	3%	NA	NA
Nondetected		26%	NA	NA	80%	NA	NA
Disagree		14%	NA	NA	17%	NA	NA
Number of Pollutants		5	NA	NA	5	NA	NA
Number of Samples		7	NA	NA	7	NA	NA
Participant C							
Agree		NA	NA	75%	NA	NA	76%
Detected	3	NA	NA	26%	NA	NA	11%
Nondetected		NA	NA	49%	NA	NA	65%
Disagree		NA	NA	25%	NA	NA	24%
Number of Pollutants		NA	NA	30	NA	NA	30
Number of Samples		NA	NA	6	NA	NA	6
Participant D							
Agree		82%	83%	83%	61%	88%	88%
Detected	3	18%	8%	17%	4%	2%	0%
Nondetected		64%	75%	66%	57%	86%	88%
Disagree		18%	17%	17%	39%	12%	12%
Number of Pollutants		11	39	23	11	39	23
Number of Samples		7	7	7	7	7	5
Participant E							
Agree		100%	75%	NA	50%	25%	NA
Detected	3	100%	75%	NA	50%	25%	NA
Nondetected		0%	0%	NA	0%	0%	NA
Disagree		0%	25%	NA	50%	75%	NA
Number of Pollutants		5	2	NA	5	2	NA
Number of Samples		2	2	NA	2	2	NA

NOTE: NA = not applicable.

Quantitative estimates of interlaboratory precision were made for each pollutant group as a pooled estimate from the individual pollutants within the group. Only the data from samples in which all of the laboratories being compared detected a particular pollutant were used in this analysis. If any of the reported concentrations were greater-than values, the data pair or data set was not used in the calculations, so as not to bias the precision estimate on the low side. Precision calculations were made on a one-to-one basis between laboratories for all possible combinations fo the three laboratory categories (EPA-, CMA-, participant-contract) for each participant. Precision calculations also were made based on all laboratories for a participant's samples when all laboratories detected a particular pollutant. The statistics for individual pollutants were pooled to provide an estimate of the interlaboratory precision for a pollutant group as a whole. As discussed previously with regard to intralaboratory precision, this was done to maximize the data base, and hence, reliability of the precision estimate for a pollutant group. It must be kept in mind that the pooling of the data in this manner may not be statistically rigorous since some of the precision estimates for individual pollutants would not be considered as estimates of the same population of precision values, and should not be pooled. The main objective in pooling the data was to provide some estimate which could characterize each pollutant group in a general way for comparative purposes within a group and between the three pollutant groups.

The interlaboratory precision between two laboratories is displayed graphically in Figures 3.1 and 3.2 for the influent and effluent samples, respectively. A measure of interlaboratory precision is the Range of Duplicates Factors (interlaboratory 95 percent confidence interval) as defined earlier in this chapter. The pooled 95 percent confidence intervals for this range are plotted for each of the different combinations of laboratories in Figures 3.1 and 3.2. The number of points lying inside the 95 percent confidence band, as well as the width of the confidence band, demonstrate the analytical repeatability between the two laboratories being compared for each pollutant group.

In addition to illustrating interlaboratory precision, the plots of the data points between laboratories shown in Figures 3.1 and 3.2 can be used to determine laboratory bias. The straight line drawn at a 45-degree angle to the

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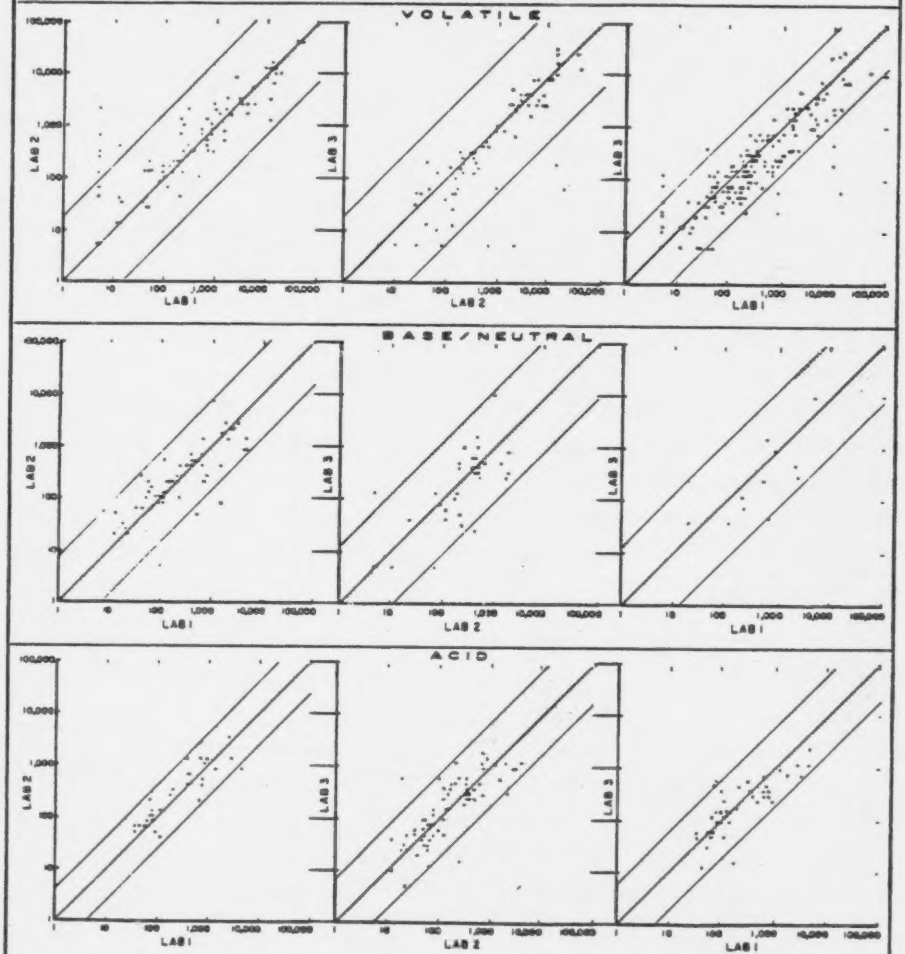
FIGURE 3.1

GRAPHICAL ILLUSTRATION OF INTERLABORATORY ANALYTICAL REPEATABILITY AND LABORATORY BIAS BETWEEN LABORATORY TYPES (INFLUENT SAMPLES)



NOTE: SHADED REGION INDICATES 95% CONFIDENCE REGION FOR ANALYTICAL REPEATABILITY

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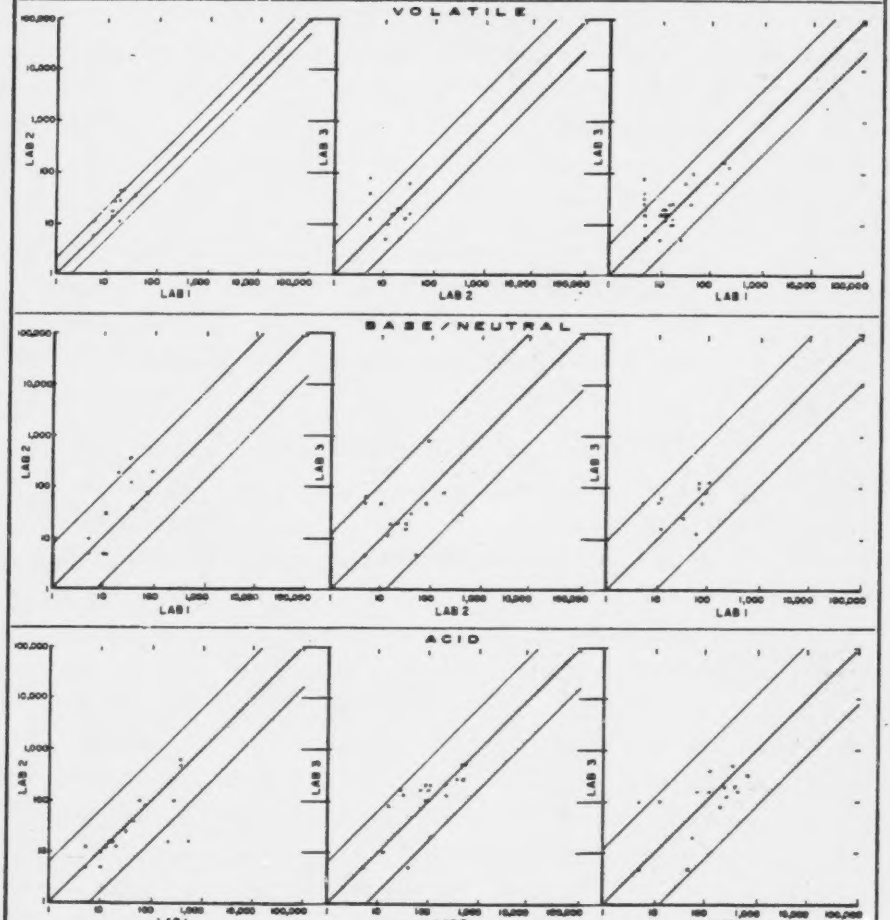
FIGURE 3.2

GRAPHICAL ILLUSTRATION OF INTERLABORATORY ANALYTICAL REPEATABILITY AND LABORATORY BIAS BETWEEN LABORATORY TYPES (EFFLUENT SAMPLES)



NOTE: SHADED REGION INDICATES 95% CONFIDENCE REGION FOR ANALYTICAL REPEATABILITY two axes and passing through the origin represents perfect correlation of analytical results between the two laboratories being compared. If the scatter of the data pairs falls uniformly above and below this line, there is no apparent bias of one laboratory relative to the other. If, however, there are more data points lying above this 45-degree line than below it, the laboratory representing the vertical axis would tend to be biased on the high side in its analytical results relative to the laboratory plotted on the horizontal axis. Evaluation of the data plotted in Figures 3.1 and 3.2 indicates that although some bias is evident between certain laboratories on particular groups of pollutants, the trend toward bias does not appear to be strong and, in general, laboratory bias does not appear to be significant in this data base.

Table 3.6 presents the interlaboratory precision between laboratory category on a one-to-one basis. These data comparing each of the laboratory categories and each pollutant group for the influent and effluent samples are essentially the same information as represented by the 95 percent confidence regions shown in Figures 3.1 and 3.2.

In Tables 3.7, 3.8, and 3.9, the interlaboratory precision data for all laboratories participating in the five-plant study is combined for each of the toxic organic pollutant groups in both the influent and effluent samples. The table indicates the concentration range measured in each pollutant group, the pooled standard deviation, the upper 95 percent reproducibility and Range of Duplicates (interlaboratory) Factors, and the number of samples used to define the precision estimates. These estimates of precision of the analytical methods used in the five-plant study provide a direct assessment of the reliability of the data base used to establish biological treatability and effluent concentrations of toxic organic pollutants in Chapter 4 of this report. The best way to demonstrate this variability, as was done earlier for the intralaboratory precision analyses, is by use of an example, as shown in Table 3.10. The significance of the two measures of interlaboratory precision for measured toxic organic pollutant concentrations in the treated effluents is demonstrated by showing the uncertainty for a single analysis on a single sample (Reproducibility Factors) or the range of values into which a second single analysis in a second laboratory could be expected to fall (Range of Duplicates Factors, interlaboratory). Comparison of these examples with the examples of intralaboratory precision shown in Table 3.10 demonstrate that

TABLE 3.6

INTERLABORATORY VARIABILITY BETWEEN LABORATORY CATEGORY ON A ONE-TO-ONE BASIS

	Influent			Effluent		
Pollutant Group	Pooled Standard Deviation ($\log_e$ scale)	Upper 95 Percent Reproducibility Factor, V_u	Upper 95 Percent Range in Duplicates Factor, R_u	Pooled Standard Deviation ($\log_e$ scale)	Upper 95 Percent Reproducibility Factor, V_u	Upper 95 Percent Range in Duplicates Factor, R_u
Volatile						
Lab 1 vs Lab 2	1.008(86)	7.21	16.32	0.274(26)	1.71	2.14
Lab 2 vs Lab 3	1.044(79)	7.74	18.03	0.518(31)	2.76	4.20
Lab 1 vs Lab 3	0.720(239)	4.10	7.35	0.535(97)	2.85	4.40
Base/Neutral						
Lab 1 vs Lab 2	0.699(55)	3.94	6.93	0.731(10)	4.19	7.58
Lab 2 vs Lab 3	0.872(36)	5.52	11.19	0.882(17)	5.63	11.51
Lab 1 vs Lab 3	0.912(11)	5.97	12.51	0.799(11)	4.79	9.15
Acid						
Lab 1 vs Lab 2	0.490(31)	2.61	3.89	0.681(24)	3.80	6.60
Lab 2 vs Lab 3	0.641(70)	3.51	5.90	0.651(20)	3.58	6.07
Lab 1 vs Lab 3	0.627(44)	3.42	5.68	0.897(16)	5.80	12.00

NOTE: (N) = N is number of data pairs.

TABLE 3.7

INTERLABORATORY PRECISION OF VOLATILE TOXIC ORGANIC POLLUTANTS

	Geometric Mean (ppb)	Pooled Standard Deviation ($\log_e$ scale)	Upper 95 Percent Reproducibility Factor (V_u)	Upper 95 Percent Range in Duplicates Factor (R_u)	Number of Samples
Influent					
Acrylonitrile	10,700	1.650	25.37	96.85	7
Benzene	487	0.487	2.60	3.86	6
Bromodichloromethane	27	0.867	5.48	11.07	2
Chlorobenzene	38	0.248	1.63	1.99	1
Chloroform	312	0.181	1.43	1.65	6
Dibromochloromethane	5	0.000	1.00*	1.00*	1
1,2-dichloroethane	506	0.513	2.73	4.14	8
1,1-dichloroethene	697	1.007	7.20	16.30	1
1,2-dichloropropane	133	0.622	3.38	5.61	6
1,3-dichloropropene	189	0.563	3.01	4.76	2
Ethylbenzene	475	0.656	3.62	6.17	15
Methylene chloride	22	2.217	77.15	466.72	5
Toluene	5,460	0.526	2.81	4.30	14
All Volatile Pollutants	799	0.782	4.63	8.74	74
Effluent					
Benzene	5	0.000	1.00*	1.00*	1
Chloroform	14	0.321	1.88	2.43	8
1,2-dichloroethane	7	0.260	1.67	2.06	6
1,2-dichloropropane	10	0.326	1.90	2.47	2
Methylene chloride	7	0.991	6.98	15.60	4
Toluene	5	0.000	1.00*	1.00*	2
All Volatile Pollutants	9	0.493	2.63	3.92	23

*All detections were less than 10 ppb.

TABLE 3.8

INTERLABORATORY PRECISION OF BASE/NEUTRAL TOXIC ORGANIC POLLUTANTS

	Geometric Mean (ppb)	Pooled Standard Deviation ($\log_e$ scale)	Upper 95 Percent Reproducibility Factor (V_u)	Upper 95 Percent Range in Duplicates Factor (R_u)	Number of Samples
Influent					
Acenaphthene	150	0.115	1.25	1.38	2
Acenaphthylene	123	0.217	1.53	1.83	2
Anthracene[1]/ Phenanthrene[1]	254	0.674	3.75	6.48	3
Benzo(a)anthracene[2]/ Chrysene[2]	31	0.347	1.98	2.62	2
Benzo(b)fluoranthene[3]/ Benzo(k)fluoranthene[3]	19	0.327	1.90	2.48	2
Benzo(a)pyrene	25	0.924	6.11	12.94	1
Bis(2-ethylhexyl)phthalate	507	0.736	4.23	7.68	6
Di-n-butylphthalate	195	0.935	6.25	13.36	6
1,2-dichlorobenzene	473	0.248	1.63	1.99	2
Diethylphthalate	414	1.027	7.48	17.23	5
Dimethylphthalate	154	1.716	28.86	116.18	4
Fluoranthene	86	0.590	3.18	5.14	3
Fluorene	99	0.368	2.06	2.78	3
Naphthalene	2,140	1.112	8.83	21.78	3
Pyrene	75	0.793	4.73	9.01	3
1,2,4-trichlorobenzene	433	0.320	1.67	2.43	1
All Base/Neutral Pollutants	213	0.923	6.10	12.92	48
Effluent					
Bis(2-ethylhexyl)phthalate	22	0.991	6.98	15.60	5
1,2,4-trichlorobenzene	63	0.297	1.79	2.28	1
All Base/Neutral Pollutants	26	0.913	5.99	12.56	6

[1,2,3] Listed as isomeric pairs as reported by laboratories.

TABLE 3.9

INTERLABORATORY PRECISION OF ACID TOXIC ORGANIC POLLUTANTS

	Geometric Mean (ppb)	Pooled Standard Deviation ($\log_e$ scale)	Upper 95 Percent Reproducibility Factor (V_u)	Upper 95 Percent Range in Duplicates Factor (R_u)	Number of Samples
Influent					
2-chlorophenol	88	0.381	2.11	2.88	2
2,4-dichlorophenol	489	0.470	2.51	3.68	2
2,4-dimethylphenol	1,260	0.617	3.35	5.53	3
2,4-dinitrophenol	1,010	0.790	4.70	8.93	7
2-nitrophenol	41	0.473	2.53	3.71	7
Pentachlorophenol	377	0.452	2.42	3.50	2
Phenol	147	0.550	2.94	4.59	19
2,4,6-trichlorophenol	90	0.734	4.21	7.65	9
All Acid Pollutants	170	0.606	3.28	5.36	51
Effluent					
2,4-dichlorophenol	64	1.281	12.31	34.83	1
Pentachlorophenol	276	0.320	1.87	2.43	2
Phenol	5	0.000	1.00*	1.00*	2
2,4,6-trichlorophenol	83	0.789	4.69	8.90	4
All Acid Pollutants	62	0.714	4.05	7.24	9

*All detections were less than 10 ppb.

TABLE 3.10

SUMMARY OF INTERLABORATORY PRECISION ON TREATED EFFLUENTS

	Volatile Group	Base/Neutral Group	Acid Group
Uncertainty in Concentration Value for a Single Analysis (Based on 95 Percent Probability)			
Single Value Found:			
100 ppb	42-263 ppb	17-599 ppb	25-405 ppb
10 ppb	4-26 ppb	2-60 ppb	3-41 ppb
Range in Concentration for a Second Single Value (Based on 95 Percent Probability)			
	Volatile Group	Base/Neutral Group	Acid Group
Given a First Analysis of:			
100 ppb	26-312 ppb	8-1,256 ppb	14-724 ppb
10 ppb	3-39 ppb	1-126 ppb	1-72 ppb

interlaboratory precision is lower for the base/neutral and acid groups of pollutants than the intralaboratory precision. That the reverse is true for the volatile group is not expected, but may be due to the data analysis procedures used.

The interlaboratory uncertainty demonstrated by this evaluation significantly affects the interpretation of the five-plant study data base for defining the performance of biological treatment in removing toxic organic pollutants. Basically, this uncertainty in the analytical technique means that a relatively large number of concentration measurements will be needed in order to estimate geometric mean concentrations and the associated standard deviations reliably for a specific toxic organic pollutant. When reviewing the treatability analyses presented in Chapter 4, this fact must be recognized. It also should be noted that a large number of nondetections of a pollutant for which analyses were conducted in the treated effluent is a significant result inasmuch as the highest qualitative agreement between laboratories occurs when a specific pollutant is not observed in a particular sample.

ACCURACY

Analytical accuracy was determined from the recovered percentage of spikes for toxic organic pollutants, surrogate compounds, and internal standards. Two methods were used during the five-plant study to measure the recovery of specific toxic organic pollutants by the analytical methods used. These recovery procedures are a measure of the accuracy of the tests for each specific compound for which a sample was analyzed. In the fortification procedure for toxic organic pollutants, the sample is split and one portion is analyzed to determine the pollutant level, then a known quantity of the specific toxic organic pollutant at a level approximately equal to the value found is added (fortification) to the other portion of the sample and the fortified sample is then analyzed. The recovery of the fortification can be calculated directly by the difference between the measured concentrations in the fortified and unfortified samples. The second approach for defining recovery by the analytical methods was the use of deuterated surrogates of the toxic organic pollutants and/or internal standards expected to have recovery characteristics in the analytical test procedure similar to the toxic organic pollutants for which a sample is being analyzed.

The recoveries obtained are shown in Tables 3.11, 3.12, and 3.13 for the volatile, base/neutral, and acid groups or toxic organic pollutants, respectively. These tables show the range of spike concentration, the mean percent recovery and associated standard deviation, and the number of samples and number of laboratories analyzing the compounds for both the influent and effluent samples of each pollutant group. Correlation coefficients were calculated between percent recovery and spike concentration. Very few toxic organic pollutants displayed relationships between these two parameters, and therefore, the correlation coefficients are not shown in the tables. Because recovery did not appear to be strongly related to spike concentration for individual pollutants, the data were pooled within pollutant groups to provide a calculated mean percent recovery for each of the three pollutant groups.

As can be seen from the recovery data in these tables, there is an extremely wide range in mean percent recovery and the associated standard deviation for both influents and effluents in all pollutant groups. Although the data appear to indicate that recoveries are lower in the treated effluent samples, the associated standard deviations are so high that there probably is no difference in the influent and effluent mean recoveries at any reasonable confidence level. With respect to the recovery of the toxic organic pollutants by groups, the volatiles have a higher mean percent recovery than the base/neutral and acid groups. In fact, the mean percent recovery for the volatile pollutants as a group is greater than 100 percent. It also should be noted that the mean percent recovery for the volatile group influents is strongly affected by a single large negative recovery for acrylonitrile (-7,000 percent). The large percent recovery for bromomethane in both the influent and effluent samples also is notable as it is the highest for all pollutants in all groups.

Table 3.14 summarizes the recoveries of the surrogate compounds and internal standards used by the laboratories participating in the five-plant study. The mean percent recoveries for these compounds are not, overall, significantly different from those calculated for the fortified samples. The associated recovery standard deviations are somewhat lower than the corresponding standard deviations for the fortified sample recovery results. Nevertheless, the recoveries shown for the surrogate compounds and internal standards are not sufficiently different than the recoveries from the

TABLE 3.11

RECOVERIES OF VOLATILE TOXIC ORGANIC POLLUTANTS IN FIVE-PLANT STUDY

	Influent				Effluent			
Pollutant	Mean Percent Recovery	Standard Deviation	Number of Samples (No. of Labs)	Range of Spike Concentration (ppb)	Mean Percent Recovery	Standard Deviation	Number of Samples (No. of Labs)	Range of Spike Concentration (ppb)
Acrylonitrile	-465	2,060	12(3)	6,190-50,000	151	131	4(1)	1,000*
Benzene	110	102	66(5)	25-10,000	83	60	61(4)	1-200
Bromomethane	643	1,883	10(1)	5,000-50,000	235	369	14(1)	100-1,000
Bromodichloromethane	112	94	15(2)	20-300	196	194	13(1)	20-25
Bromoform	120	-	1(1)	10,000*	-	-	0(0)	-
Carbon tetrachloride	176	71	5(2)	50-10,000	96	2	2(1)	24-26
Chlorobenzene	136	91	26(4)	20-10,000	107	26	18(1)	20-200
Chloroethane	210	178	6(1)	96-482	-	-	0(0)	-
Chloroform	165	150	31(4)	10-10,000	103	62	33(3)	2-200
Dibromochloroethane	95	51	13(1)	20*	-	-	0(0)	-
1,1-dichloroethane	169	270	6(1)	20-100	167	68	5(2)	20-24
1,2-dichloroethane	203	164	32(4)	100-10,000	105	73	28(3)	6-200
1,1-dichloroethene	[illegible]	112	32(4)	20-11,000	96	67	26(2)	10-200
t-1,2-dichloroethene	182	144	7(2)	100-10,000	143	87	9(2)	20-200
1,2-dichloropropane	300	318	23(2)	30-2,000	62	98	18(2)	1-30
1,3-dichloropropene	67	109	19(1)	20-500	64	58	13(2)	4-40
Ethylbenzene	161	130	53(4)	80-140,000	113	81	[illegible]	1-200
Methylene chloride	[illegible]	695	[illegible]	20-10,000	79	128	22(2)	1-137
1,1,2,2-tetrachloroethane	125	164	4(2)	20-60	-	-	0(0)	-
Tetrachloroethene	206	119	12(3)	10-1,000	96	18	6(2)	20-250
1,1,1-trichloroethane	192	105	20(1)	20-50	117	134	20(2)	1-20
1,1,2-trichloroethane	[illegible]	132	3(1)	20*	0	-	1(1)	1*
Trichloroethene	210	153	20(3)	13-10,000	122	92	23(2)	1-200
Trichlorofluoromethane	-	-	0(0)	-	129	119	7(1)	20*
Toluene	57	167	49(4)	100-60,000	112	82	44(4)	1-200
All Volatile Pollutants	151	472	456	10-140,000	110	115	398	1-1,000

*All spike concentrations at this level.

TABLE 3.12

RECOVERIES OF BASE/NEUTRAL TOXIC ORGANIC POLLUTANTS IN FIVE-PLANT STUDY

	Influent				Effluent			
Pollutant	Mean Percent Recovery	Standard Deviation	Number of Samples (No. of Labs)	Range in Spike Concentration (ppb)	Mean Percent Recovery	Standard Deviation	Number of Samples (No. of Labs)	Range in Spike Concentration (ppb)
Acenaphthene	84	40	4(1)	140-260	-	-	0(0)	-
Acenaphthylene*	127	64	4(1)	90-190	0	-	1(1)	2**
Anthracene¹/Phenanthrene¹	67	71	7(1)	1-540	27	46	3(1)	1-10
Benzo(a)anthracene²/ Chrysene²	77	62	5(1)	2-100	80	-	1(1)	80**
Benzo(b)fluoranthene³/ Benzo(k)fluoranthene³	141	214	4(1)	3-50	68	-	1(1)	90**
Benzo(a)pyrene	158	281	6(1)	7-370	42	-	1(1)	60**
Bis(2-ethylhexyl)phthalate	44	34	18(3)	180-5,270	46	94	17(3)	6-220
Butylbenzylphthalate*	6	8	2(1)	6-25	-	-	0(0)	-
Chrysene	-	-	0(0)	-	100	-	1(1)	2**
Dibenzo(a,h)anthracene	-97	-	1(1)	30**	231	-	1(1)	80**
Di-n-butylphthalate	37	57	16(3)	20-2,050	27	42	17(4)	1-130
1,2-dichlorobenzene	65	68	21(2)	8-1,250	116	73	23(2)	11-250
Diethylphthalate*	46	43	16(3)	200-2,500	40	133	14(2)	5-50
Dimethylphthalate	205	536	12(3)	10-1,000	1	1	3(1)	1-50
Dioctylphthalate	-13	28	2(1)	18-70	0	0	2(1)	2**
Fluoranthene	42	41	8(2)	10-220	55	-	1(1)	20**
Fluorene	105	56	4(1)	60-200	-	-	0(0)	-
Naphthalene	125	248	5(1)	7-2,600	69	43	2(2)	20-54
Nitrobenzene	74	24	26(2)	100-25,000	66	36	30(2)	20-500
Pyrene	49	54	9(2)	1-220	55	-	1(1)	20**
1,2,4-trichlorobenzene*	96	76	23(2)	40-1,875	104	55	30(3)	10-500
All base/neutral pollutants	79	157	197	1-25,000	70	76	149	1-500

*Note: There was some question in the proper identification of these compounds in some of the samples, based on the following information:

(1) 1,2,4-trichlorobenzene - most likely the co-isomer, 2,4,6-trichlorobenzene, which is not on the priority pollutant list.
(2) Diethylphthalate - interference with dimethyl nitroaniline which coelutes with the phthalate ester.
(3) Acenaphthylene - interference with dichloroaniline or biphenyl which coelutes with acenaphthylene.
(4) Butylbenzylphthalate - most likely a product from a manufacturing process and not the phthalate ester.

**All spike concentrations at this level.

¹,²,³Reported as isomer pairs.

TABLE 3.13

RECOVERIES OF ACID TOXIC ORGANIC POLLUTANTS IN FIVE-PLANT STUDY

	Influent				Effluent			
Pollutant	Mean Percent Recovery	Standard Deviation	Number of Samples (No. of Labs)	Range in Spike Concentration (ppb)	Mean Percent Recovery	Standard Deviation	Number of Samples (No. of Labs)	Range in Spike Concentration (ppb)
4-chloro-3-methylphenol	127	-	1(1)	60*	172	111	2(1)	8-40
2-chlorophenol	94	55	28(3)	2-625	62	40	36(4)	1-625
2,4-chlorophenol	99	44	22(2)	2-875	74	58	25(3)	10-500
2,4-dimethylphenol	8	25	4(1)	5-1,400	0	-	1(1)	6*
2,4-dinitrophenol	104	95	24(3)	200-4,000	52	57	25(3)	50-750
2-methyl-4,6-dinitrophenol	-	-	0(0)	-	76	21	6(1)	80-200
2-nitrophenol	61	59	23(2)	2-301	70	38	21(3)	5-70
4-nitrophenol	71	20	17(1)	80-300	61	19	18(1)	30-200
Pentachlorophenol	84	43	23(2)	4-2,500	94	54	35(4)	5-1,500
Phenol	72	95	67(4)	13-5,201	55	37	63(6)	1-438
2,4,6-trichlorophenol	78	46	39(4)	50-1,250	66	90	50(6)	5-750
All Acid Pollutants	80	70	248	2-5,201	67	57	282	1-1,500

*All spike concentrations at this level.

TABLE 3.14

RECOVERIES OF SURROGATE COMPOUNDS AND INTERNAL STANDARDS IN FIVE-PLANT STUDY

Compound	Influent			Effluent		
	Mean Percent Recovery	Standard Deviation (percent)	Number of Samples (No. of Labs)	Mean Percent Recovery	Standard Deviation (percent)	Number of Samples (No. of Labs)
Aniline-d_5	41	38	16(1)	35	27	19(1)
Benzene-d_6	95	46	137(4)	90	41	148(4)
Decafluorobiphenyl	75	51	49(2)	68	51	49(2)
1,2-dichloroethane-d_4	108	19	5(1)	113	14	12(1)
1,4-dichloroethane-d_4	-	-	0(0)	108	0	2(1)
m-difluorobenzene	109	45	96(2)	109	23	92(2)
2,2-difluorobiphenyl	41	29	16(1)	38	27	19(1)
2,2-difluorotetrachloroethane	105	48	96(2)	101	37	92(2)
2-fluorobiphenyl	81	37	56(3)	82	38	61(3)
2-fluoronaphthalene	64	41	16(1)	43	33	19(1)
2-fluorophenol	102	47	42(1)	89	26	34(1)
Methylene chloride-d_2	66	38	65(2)	63	28	69(2)
Naphthalene-d_8	115	57	33(1)	108	33	30(1)
Nitrobenzene-d_5	98	88	80(2)	67	68	30(2)
Pentafluorobenzene	114	103	53(1)	121	44	49(1)
Pentafluorophenol	105	47	42(1)	91	27	36(1)
Phenol-d_2	90	66	66(2)	99	16	12(2)
Toluene-d_8	100	44	137(4)	88	32	148(4)
Trifluoro-m-cresol	112	42	36(1)	111	29	36(1)
Trifluorophenol	109	16	2(1)	-	-	-(0)

fortified samples to merit the conclusion that one approach is better than the other.

The overall result of the evaluation of the pollutant recoveries demonstrated by the laboratories participating in the five-plant study is that the accuracy of the analytical methods used for the toxic organic pollutants is low. The large standard deviation in individual pollutant recoveries definitely does not support the use of a recovery correction as part of the analytical methodology. These recovery data do not indicate that either the mean recovery or the recovery standard deviation is statistically different for the influent and effluent samples for either the fortified samples or the surrogates and internal standards.

A final factor which impacts upon the accuracy of the analytical method is the number of reports of toxic organic pollutants in blank samples. Table 3.15 summarizes the number of detections and the associated geometric mean concentrations and standard deviations for all toxic organic pollutants reported in blank samples by the laboratories. Although the geometric mean concentrations are not high, the data in Table 3.15 illustrate yet another factor which can influence the reliability of the analytical results for the toxic organic pollutants both as presented in this study and as might be used for determination of effluent limitations guidelines and compliance or noncompliance with wastewater discharge permits.

CLASSIFICATION OF ANALYTICAL DATA USABILITY

The evaluation presented in the preceding section demonstrates that the analytical methodologies used for the measurement of toxic organic pollutants in both untreated and treated wastewaters from the organic chemicals industry are subject to considerable uncertainty. The examples given in Tables 3.4 and 3.10 are particularly useful in assessing the significance of this analytical uncertainty with respect to an individual sample of influent or effluent wastewater. Of even greater concern is the relatively low level of accuracy of these analytical methods as demonstrated by the poor recovery of these pollutants from fortified samples or when using surrogate compounds or internal standards. The analysis performed by ES indicates that these analytical methods can be considered to be at best of qualitative value when applied to an individual sample collected from a particular influent or

TABLE 3.15

TOXIC ORGANIC POLLUTANTS
REPORTED IN BLANK SAMPLES

	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections
Benzene	7	0.638	14
Chloroform	5*	0.000**	6
Ethylbenzene	5*	0.000	5
Methylene chloride	11	1.182	21
1,1,1-trichloroethane	8	0.855	3
Trichloroethene	5*	0.000**	3
Trichlorofluoromethane	5*	-	1
Toluene	5	0.000**	15

*If measured concentrations were below 10 ppb, a value of 5 ppb was used in the statistics.

**If all reported values were below 10 ppb and thus set to 5 ppb, the standard deviation was zero.

effluent. This study demonstrates that analytical uncertainty must be explicitly recognized if numerical effluent limits are established.

It is not a contradiction to say that the overall five-plant study data base is suitable for the purpose of determining whether or not biological treatment effectively removes the toxic organic pollutants. The large number of samples collected from both the influent and effluent of each participating treatment plant, the multiple analyses of many of the samples by separate laboratories, and the large number of replicates run by each laboratory all significantly enhance the usefulness of the data base. This is particularly true when assessing the treatability of pollutant groups by the participating biological treatment plants. The data base becomes less reliable when the influent or effluent concentration or standard deviation of a specific toxic organic pollutant is considered. As mentioned earlier, however, there are often few toxic organic pollutants detected in treated effluents, resulting in poor estimates of geometric mean concentrations and standard deviations. This situation is mitigated by the fact that if there were a large number of detections of the same toxic organic pollutant in the influent at high concentrations, its absence in the effluent can be interpreted as essentially total removal corresponding to zero concentrations, and thus the geometric mean would be overestimated.

In summary, the impact of the high levels of analytical imprecision on statements about pollutant removal in biological treatment systems is ameliorated by the large number of samples, replicate analysis of many samples, and design of this program. This same high level of uncertainty invalidates the use of one or two values on a single sample as an accurate and precise estimate of the true concentration of a specific toxic organic pollutant in that sample.

CHAPTER 4

TREATMENT SYSTEM PERFORMANCE

This chapter presents the results of the detailed analysis of treatment performance data collected at each of the participating facilities. The scope of the data collection effort for the five-plant study was described in Chapter 2. The evaluation of treatment system performance is presented in terms of selected conventional and nonconventional pollutants and the toxic organic pollutants measured in the influent and effluent of each participant's biological treatment system. A description of the analysis approach used for each of these two major types of wastewater constituents is presented prior to the summary of the results of the evaluation.

Before proceeding with the discussion of the statistical analysis procedures used to evaluate the performance of the biological treatment system, it is important to recognize the significance of the accuracy, precision, and reproducibility of the analytical methods used for measurement of the toxic organic pollutants, as has been discussed in Chapter 3. Variability inherent in the analytical methods for toxic organic pollutants has been a significant limitation on the suitability of the available data base (for example, from the screening and verification phase surveys) for establishing reliable effluent limitations guidelines. Evaluation of the analytical variability associated with the samples collected and analyzed during the five-plant study has demonstrated that intralaboratory and interlaboratory uncertainty remains the dominant factor controlling use of the toxic organic pollutant data base. The large number of influent and effluent samples collected during this study as well as the extensive analytical quality control and quality assurance programs which were part of this data collection effort make the results of the five-plant study far more reliable as a basis for predicting treatment system performance and effluent concentrations of toxic organic pollutants than any other data base available for the organic chemicals industry. Notwithstanding this fact, however, caution must be used when interpreting quantitative concentrations of individual pollutants measured in the influents and effluents of the biological treatment systems. The extensiveness of the five-plant study data base moderates but does not eliminate the inherent analytical uncertainty associated with the toxic organic pollutant test procedures as described in Chapter 3. For the purposes of demonstrating treatment system performance and making statements about expected effluent concentrations of toxic organic pollutants from biological treatment systems in the organic chemicals industry, the five-plant study data base is reliable, extensive, and accurate.

Both the influent and effluent data bases for the five-plant study were statistically analyzed to define performance levels of the treatment systems and influent and effluent variability for each pollutant measured. The influent and effluent data were assumed to be represented best by logarithmic normal distributions (log normal). The log normal distribution is the commonly accepted probability distribution for wastewater treatment influent and effluent data. When the log normal probability distribution is used to describe influent and effluent data, it must be understood that the measure of central tendency for the data base is the geometric mean rather than the arithmetic mean. The geometric mean is equal to the median of the set of data when the data closely follow the log normal probability distribution assumption. The arithmetic mean also is calculated and used in the performance analyses presented in this report. This is done because typically it has been used by the EPA Effluent Guidelines Division for establishing the long-term performance of wastewater treatment systems. It must be recognized, however, that the arithmetic mean can be biased significantly upwards by as few as one or two very high values as compared to the rest of the values in a data base. This is particularly important in an analysis of the toxic organic pollutant data because, as shown in the evaluation of the analytical methodology presented in Chapter 3 of this report, occasional extremely high concentrations are possible due to analytical error alone. This will tend to bias the arithmetic mean much more than it would bias the geometric mean of a set of data.

The purpose for fitting the statistical distributions to the influent and effluent data is to allow definition of the variability in effluent quality and treatment system performance for each pollutant studied. This influent and effluent variability can be defined both by the geometric standard deviation of the applicable probability distribution for an individual pollutant and the so-called EPA variability factor. The EPA variability factor, as defined in this report, is the ratio of the 99 percentile maximum influent or effluent concentration to the corresponding long-term arithmetic average influent and effluent concentration for the pollutant of interest. Note that the arithmetic mean concentration is used rather than the geometric mean in order to remain consistent with the procedures and terminology developed by EPA Effluent Guidelines Division. Because of the potential bias in the arithmetic means of the toxic organic pollutant data, a better measure of the effluent variability ratio probably would be the 99 percentile concentration for the toxic pollutant divided by the geometric mean concentration, which is the measure of central tendency for a log normal probability distribution. The variability ratio expressed in this latter format always will be higher than the EPA variability ratio as defined and used in this report.

CONVENTIONAL AND NONCONVENTIONAL POLLUTANTS

The conventional and nonconventional pollutants analyzed in the influents and effluents of the participants' biological treatment systems were total five-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), chemical oxygen demand (COD), total organic carbon (TOC), and total oxygen demand (TOD). The specific conventional and nonconventional pollutants measured by each participant were those routinely used for treatment process operation and/or discharge monitoring reporting. Thus, not all participants measured the same conventional and nonconventional pollutants during the course of the five-plant study.

Table 4.1 presents the data on conventional and nonconventional pollutants which were collected from the influent and effluent of the participants' wastewater treatment systems. These data represent treatment performance for the removal of these pollutants during the time periods that the survey was being conducted as shown in Table 2.3. Indicated in Table 4.1 along with the geometric mean concentrations, percent removal, and EPA effluent variability factors for each conventional and nonconventional pollutant are the number of samples on which the performance estimates are based.

As can be seen from reviewing the data shown in Table 4.1, the performance of the participating biological waste treatment plants during the five-plant study was excellent. Removal of the wastewater constituents which

TABLE 4.1

WASTEWATER TREATMENT SYSTEM PERFORMANCE CONVENTIONAL/NONCONVENTIONAL POLLUTANTS

Pollutant	Participant				
	A	B	C	D	E
BOD_5 (mg/l)					
Influent	582(29)	450(32)	841(24)	1,280(52)	48(5)
Effluent	18(29)	14(30)	3(24)	19(52)	14(5)
Percent Removal	97	97	99	99	71
Effluent V_{EPA}*	6.00	3.15	4.13	3.59	3.65
COD (mg/l)					
Influent	1,180(29)	752(30)	1,740(24)	NA	NA
Effluent	153(28)	95(30)	123(24)	NA	NA
Percent Removal	87	87	93	NA	NA
Effluent V_{EPA}	2.13	2.12	1.46	NA	NA
TSS (mg/l)					
Effluent	65(28)	10(30)	12(39)	30(53)	16(18)
Effluent V_{EPA}	3.56	3.87	2.77	3.18	2.82
TOC (mg/l)					
Influent	378(29)	NA	485(24)	651(54)	54(5)
Effluent	39(29)	NA	35(24)	60(54)	23(5)
Percent Removal	90	NA	93	91	57
Effluent V_{EPA}	1.87	NA	1.42	2.14	2.59
TOD (mg/l)					
Influent	NA	NA	NA	NA	474(5)
Effluent	NA	NA	NA	NA	147(5)
Percent Removal	NA	NA	NA	NA	69
Effluent V_{EPA}	NA	NA	NA	NA	1.20

*V_{EPA} - daily variability factor as defined by EPA Method (Ref. 4.1).

NA - not available.

(N) - is number of samples analyzed.

are a measure of the organic content of the wastewaters (BOD_5, COD, TOC, and TOD) generally was better than 90 percent. The only exceptions to this high removal percentage were for Participant E. The reason for these exceptions was that the influent wastewaters contained very low concentrations of BOD_5, TOC, and TOD. In terms of average effluent concentration for BOD_5, these treatment systems would rank in the highest 34 percent of all organic chemicals and combined organic chemicals/plastics treatment systems analyzed by EPA for development of effluent limitations guidelines (Ref. 4.1). With respect to the pollutant COD, the effluent concentrations for the three of the five participants reporting such data would rank them in the top 45 percentile of all plants analyzed by EPA in that study.

The effluent quality of the participating biological treatment plants also was excellent in terms of TSS concentration. With respect to this pollutant parameter, there was considerably greater difference between participants in terms of effluent quality than there was for the conventional and nonconventional pollutants which measure the organic content of the wastewater. ES' experience indicates a wide range of effluent TSS concentrations from activated sludge units will occur because of the varying characteristics of wastewaters from the chemical processing industry. The analysis conducted for EPA of their data base for effluent guidelines development similarly shows a fairly wide range in effluent TSS concentrations. Including the highest geometric mean effluent TSS concentration shown in Table 4.1, this group of plants ranks in the best 79 percent of all chemicals and chemicals/plastics plants in EPA's data base (Ref. 4.1).

TOXIC POLLUTANTS

As discussed in Chapter 2, not all of the five participating plants were sampled for all of the toxic organic pollutants which were the subject of the five-plant study. The selection of which pollutants would be sampled at each participant's plant was made by EPA and the participating company. In order to preserve confidentiality, therefore, the toxic organic pollutant data collected from the influents and effluents of each of the participants' biological waste treatment plants were pooled for the performance analysis. The number of plants at which each of the toxic organic pollutants actually was detected in the influent and/or effluent was presented in Chapter 2.

Where the same toxic organic pollutant was found in two or more participants' influents and effluents, this pooling of the data base increases the number of observations of the pollutant and thus the reliability of the performance estimates. ES believes that this pooling of the toxic pollutant data is acceptable because of the very similar performance observed at each of the participating biological treatment plants for the removal of the conventional and nonconventional organic related pollutants.

This pooling of the toxic organic pollutant data also includes using all samples analyzed by all laboratories participating in the survey. In some cases, this means that three separate analyses are available and were used for a given 24-hour influent and effluent composite sampling. The evaluation of the analytical methodologies indicate that this pooling of analytical data from separate laboratories participating in the survey is statistically acceptable. It should be recognized, however, that this approach; that is, pooling three analyses of what is essentially a single sample for a given day, significantly increases the reliability of that estimate of influent and effluent quality for a particular toxic organic pollutant, as compared to collection and analysis of a single composite sample. For the purpose of this study, which is to define the performance of biological treatment systems in removing toxic pollutants, this effect of the data handling procedure used is desirable. In the context of effluent limitations, however, it must be recognized that the actual variability in effluent quality for a specific toxic organic pollutant is underestimated by the approach used to analyze these performance data since analytical uncertainty is reduced by pooling the analyses on a single sample. Higher variability factors than the ones shown in this report will occur when individual effluent composites are analyzed for a given toxic organic pollutant.

Tables 4.2, 4.3, and 4.4 present the treatment plant performance data for the removal of the volatile organic pollutants, base/neutral extractable organic pollutants, and the acid extractable organic pollutants, respectively. These pollutant groups will be referred to hereinafter as the volatile, base/neutral, and acid groups of toxic organic pollutants. Shown in each of these tables are the influent and effluent geometric mean concentrations for each individual toxic organic pollutant detected in the five participating biological treatment systems. The geometric standard deviation

TABLE 4.2

TREATMENT SYSTEM PERFORMANCE FOR VOLATILE COMPOUNDS

	Influent			Effluent			
Compound	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	Percent Removal
Acrylonitrile	10,300	1.902	47	65	1.877	3	99
Benzene	581	1.9[illegible]3	129	6	0.704	58	99
Bromomethane	1,250	1.396	9	ND	-	0	100
Bromodichloromethane	20	1.251	29	5	0.000*	9	75
Carbon tetrachloride	51	2.025	3	ND	-	0	100
Chlorobenzene	20	1.086	29	16	-	1	20
Chloroethane	12	1.755	19	5	0.000*	2	58
Chloroform	348	2.230	63	13	0.879	62	96
Dibromochloromethane	6	0.475	22	ND	-	0	100
1,1-dichloroethane	9	1.398	22	5	-	1	44
1,2-dichloroethane	524	1.252	73	9	1.031	64	98
1,1-dichloroethene	42	2.064	53	ND	-	0	100
t-1,2-dichloroethene	42	1.931	7	5	0.000*	3	88
1,2-dichloropropane	138	1.133	54	7	0.619	27	95
1,3-dichloropropene	148	1.199	47	6	0.315	19	96
Ethylbenzene	283	1.640	107	5	0.000*	25	98
Methylene chloride	17	1.529	61	9	0.893	58	47
1,1,2,2-tetrachloroethane	17	1.733	2	5	-	1	71
Tetrachloroethene	6	0.521	31	5	0.000*	3	17
1,1,1-trichloroethane	7	0.543	38	5	0.000*	19	29
1,1,2-trichloroethane	12	0.876	15	5	-	1	58
Trichloroethene	7	0.586	31	5	0.000*	19	29
Trichlorofluoromethane	ND	-	0	8	0.824	4	-
Toluene	4,500	0.809	112	7	0.788	51	100
Vinyl chloride	6	0.438	4	ND	-	0	100
All Volatile Pollutants	166	2.655	1,007	8	0.831	430	95

NOTE: ND - not detected.

*All detections were less than 10 ppb.

TABLE 4.3

TREATMENT SYSTEM PERFORMANCE FOR BASE/NEUTRAL COMPOUNDS

	Influent			Effluent			
Compound	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	Percent Removal
Acenaphthene	84	0.611	9	5	0.000*	2	94
Acenaphthylene**	65	0.514	10	5	0.000*	3	92
Anthracene[1]/ Phenanthrene[1]	62	1.635	14	6	0.449	6	90
Benzo(a)anthracene[2]/ Chrysene[2]	20	1.027	10	8	1.111	6	60
Benzo(b)fluoranthene[3]/ Benzo(k)fluoranthene[3]	11	0.979	10	11	1.112	7	0
Benzo(a)pyrene	13	0.953	11	18	1.814	2	-
Bis(2-ethylhexyl)phthalate	24	2.070	47	29	1.362	44	-
Butylbenzylphthalate**	12	1.529	5	5	-	1	58
Chrysene	ND	-	0	5	-	1	-
Dibenzo(a,h)anthracene	15	-	1	75	-	1	-
Di-n-butylphthalate	36	2.098	44	6	0.762	24	83
1,3-dichlorobenzene*/ 1,4-dichlorobenzene*	5	-	1	ND	-	0	100
1,2-dichlorobenzene	331	1.354	43	28	1.105	17	92
Diethylphthalate**	134	1.964	36	9	0.693	19	93
Dimethylphthalate	46	2.011	31	5	0.000*	8	89
Dioctylphthalate	28	1.117	6	5	0.000*	3	82
Fluoranthene	17	1.347	19	6	0.577	7	65
Fluorene	56	0.693	10	5	-	1	91
Isophorone	650	-	1	ND	-	0	100
Naphthalene	802	1.930	11	6	0.460	5	99
Nitrobenzene	3,000	2.010	32	91	1.775	2	97
Pyrene	17	1.357	19	6	0.496	10	65
1,2,4-trichlorobenzene**	234	1.026	46	39	1.097	39	83
All Base/Neutral Pollutants	119	2.157	416	15	1.271	208	87

[1,2,3,*] Reported as isomer pairs.

NOTE: ND - not detected.

*All detections were less than 10 ppb.

**Note: There was some question in the proper identification of these compounds in some of the samples, based on the following information:

(1) 1,2,4-trichlorobenzene – most likely the co-isomer, 2,4,6-trichlorobenzene, which is not on the priority pollutant list.
(2) Diethylphthalate – interference with dimethyl nitroaniline which coelutes with the phthalate ester.
(3) Acenaphthylene – interference with dichloroaniline or biphenyl which coelutes with acenaphtylene.
(4) Butylbenzylphthalate – most likely a product from a manufacturing process and not the phthalate ester.

TABLE 4.4

TREATMENT SYSTEM PERFORMANCE FOR ACID COMPOUNDS

Compound	Influent			Effluent			Percent Removal
	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	Geometric Mean (ppb)	Standard Deviation ($\log_e$ scale)	Number of Detections	
4-chloro-3-methylphenol	ND	-	0	8	0.676	2	-
2-chlorophenol	53	1.183	57	35	1.085	23	34
2,4-dichlorophenol	347	0.765	43	24	1.062	33	93
2,4-dimethylphenol	270	1.992	12	5	0.000*	8	98
2,4-dinitrophenol	673	1.247	44	59	1.645	6	91
2-nitrophenol	40	0.628	38	9	0.634	4	78
Pentachlorophenol	216	1.330	49	115	1.462	57	47
Phenol	171	1.820	137	10	0.976	55	94
2,4,6-trichlorophenol	100	1.210	89	53	1.242	72	47
All Acid Pollutants	150	1.586	469	34	1.503	260	77

NOTE: ND - not detected.

*All detections were less than 10 ppb.

and the number of detections upon which the geometric mean and standard deviation are based also are shown in the tabulations. The percent removal for each toxic organic pollutant in each of the three groups which is tabulated was calculated using the geometric mean influent and effluent concentrations. Also shown in the tabulations are the same statistics for all of the pollutants in each group (volatiles, base/neutral, and acid).

The performance data presented in Tables 4.2 through 4.4 are largely self-explanatory. In general, the performance data indicate that the toxic organic pollutants in all groups, with only a few exceptions, are removed by the biological treatment systems to effluent concentrations very close to or below the detection limit (10 ppb) accepted for the analytical methodologies used in this study. Of the 52 toxic organic pollutants reported in the effluents from the five participating plants (counting the four base/neutral isomeric pairs as eight compounds), 36 of the geometric mean effluent concentrations were below 10 ppb, 10 were between 10 and 50 ppb, five were between 50 and 100 ppb, and only one (pentachlorophenol at 115 ppb) was over 100 ppb concentration. As discussed in the previous evaluation of the analytical reliability of the techniques used for measurement of these pollutants, potentially great uncertainty exists that a specific toxic organic pollutant will be present and/or there is a potentially large uncertainty in measured concentrations below 100 ppb. Thus, a general conclusion which can be drawn from the performance data presented in Tables 4.2 through 4.4 is that essentially all of the toxic organic pollutants are removed effectively in biological treatment plants to average long-term effluent concentrations which are at the limit of the accuracy, repeatability, and reproducibility of the analytical methods used to determine their presence.

Several observations are warranted with respect to the performance data shown in these tables. First, it is important to note that in many if not most cases there are significantly fewer observations of a specific organic pollutant in the treated effluent than there are in the influent. Since these studies were conducted over a continuous period of time (with the exception of weekends), it can be assumed that in most cases these missing observations can be construed as meaning that essentially 100 percent of the influent loading of the particular organic pollutant was removed by the biological treatment system. This factor has not been built into the percent removal values shown in Tables 4.2 through 4.4. Second, it should be noted that many of the low percent removals occur when the influent concentration of the specific organic pollutant is very low. This, obviously, is to be expected. Finally, it is very important to note the number of observations on which the statistical parameters for each pollutant are based; in many cases, particularly with respect to the treated effluent, a very small number of detections were found during the study and serve as the basis for the statistical analysis. In the case where there are a large number of influent detections for the same pollutant, it can be assumed that a pollutant showing a very small number of effluent observations is essentially totally removed by biological treatment. In the case of pollutants where a very low number of influent samples also exist, conclusions with respect to long-term treatability must be made with caution.

One effective way of aggregating the data to get an overall view of the performance of the biological treatment systems for the toxic organic pollutants is to examine the removal of the pollutants by group. Based on the log normal statistics, the removal of the volatile pollutants was highest at 95.2 percent, base/neutral pollutants are second at 87.4 percent, and the removal of the acid pollutants is the lowest at 77.3 percent. Care must be taken in generalization of these removals, however, inasmuch as the factor stated above with respect to the relationship between influent and effluent concentrations for a particular pollutant and the number of pollutants actually detected in the influent and effluent have a significant impact on these averages. The geometric average effluent concentrations for each of these groups which are volatiles, 8 ppb; base/neutrals, 15 ppb; and acids, 34 ppb; also support the generalization with respect to the relative treatability of each pollutant group.

As discussed earlier in this report, EPA has typically used arithmetic mean concentrations to establish long-term average treatability and effluent variability for setting effluent limitations guidelines. Tables 4.5 through 4.7 present calculated arithmetic mean influent and effluent concentrations and the EPA variability factors for the volatile, base/neutral, and acid toxic organic pollutant groups, respectively. Also included in these tables are the number of detections of each pollutant in the influent and

TABLE 4.5

PERCENT REMOVAL AND EPA VARIABILITY FACTORS FOR VOLATILE COMPOUNDS

Compound	Influent			Effluent			Percent Removal
	Arithmetic Mean (ppb)	Number of Detections	EPA Variability Factor (V_{EPA})	Arithmetic Mean (ppb)	Number of Detections	EPA Variability Factor (V_{EPA})	
Acrylonitrile	67,900	47	13.68	378	3	13.53	99
Benzene	3,990	129	14.01	8	58	4.01	100
Bromomethane	3,310	9	9.71	ND	0	-	100
Bromodichloromethane	44	29	8.40	5	9	1.00*	89
Carbon tetrachloride	396	3	14.30	ND	0	-	100
Chlorobenzene	36	29	6.94	16	1	-	56
Chloroethane	56	19	12.71	5	2	1.00*	91
Chloroform	4,180	63	14.90	19	62	5.25	99
Dibromochloromethane	7	22	2.70	ND	0	-	100
1,1-dichloroethane	24	22	9.73	5	1	-	79
1,2-dichloroethane	1,150	73	8.40	15	64	6.47	99
1,1-dichloroethene	353	53	14.46	ND	0	-	100
t-1,2-dichloroethene	271	7	13.84	5	3	1.00*	98
1,2-dichloropropane	262	54	7.34	8	27	3.48	97
1,3-dichloropropene	304	47	7.93	6	19	1.98	98
Ethylbenzene	1,090	107	11.83	5	25	1.00*	99
Methylene chloride	55	61	10.89	13	58	5.36	75
1,1,2,2-tetrachloroethane	76	2	12.55	5	1	-	93
Tetrachloroethene	7	31	2.93	5	3	1.00*	27
1,1,1-trichloroethane	8	38	3.05	5	19	1.00*	38
1,1,2-trichloroethane	18	15	5.23	5	1	-	72
Trichloroethene	8	31	3.29	5	19	1.00*	40
Trichlorofluoromethane	ND	0	-	11	4	4.85	-
Toluene	6,240	112	4.73	10	51	4.58	100
Vinyl chloride	7	4	2.52	ND	0	-	100
All Volatile Pollutants	5,630	1,007	14.18	11	430	4.90	100

NOTE: ND - not detected.

*All detections were less than 10 ppb.

TABLE 4.6
PERCENT REMOVAL AND EPA VARIABILITY FACTORS FOR BASE/NEUTRAL COMPOUNDS

	Influent			Effluent			
Compound	Arithmetic Mean (ppb)	Number of Detections	EPA Variability Factor (V_{EPA})	Arithmetic Mean (ppb)	Number of Detections	EPA Variability Factor (V_{EPA})	Percent Removal
Acenaphthene	101	9	3.44	5	2	1.00*	95
Acenaphthylene**	74	10	2.90	5	3	1.00*	93
Anthracene[1]/ Phenanthrene[1]	256	14	12.18	7	6	2.57	97
Benzo(a)anthracene[2]/ Chrysene[2]	34	10	6.43	15	6	7.15	56
Benzo(b)fluoranthene[3]/ Benzo(k)fluoranthene[3]	18	10	6.04	20	7	7.16	-
Benzo(a)pyrene	20	11	5.83	93	2	13.12	-
Bis(2-ethylhexyl)phthalate	204	47	14.48	73	44	9.58	64
Butylbenzylphthalate**	39	5	10.89	5	1	-	87
Chrysene	ND	0	-	5	1	-	-
Dibenzo(a,h)anthracene	15	1	-	75	1	-	-
Di-n-butylphthalate	777	44	14.58	8	24	4.41	99
1,3-dichlorobenzene[4]/ 1,4-dichlorobenzene[4]	5	1	-	ND	0	-	100
1,2-dichlorobenzene	828	43	9.33	52	17	7.10	94
Diethylphthalate**	922	36	14.02	11	19	3.94	99
Dimethylphthalate	347	31	14.24	5	8	1.00*	99
Dioctylphthalate	52	6	7.20	5	3	1.00*	90
Fluoranthene	42	19	9.27	7	7	3.24	83
Fluorene	71	10	3.94	5	1	-	93
Isophorone	650	1	-	ND	0	-	100
Naphthalene	5,160	11	13.84	7	5	2.63	100
Nitrobenzene	22,600	32	14.24	440	2	12.86	98
Pyrene	43	19	9.36	7	10	2.80	84
1,2,4-trichlorobenzene**	396	46	6.43	71	39	7.03	82
All Base/Neutral Pollutants	1,220	416	14.75	34	208	8.58	97

[1,2,3,4] Reported as isomer pairs.

NOTE: ND - not detected.

*All detections were less than 10 ppb.

**Note: There is some question in the proper identification of these compounds in some of the samples, based on the following information:

(1) 1,2,4-trichlorobenzene – most likely the co-isomer, 2,4,6-trichlorobenzene, which is not on the priority pollutant list.
(2) Diethylphthalate – interference with dimethyl nitroaniline which coelutes with the phthalate ester.
(3) Acenaphthylene – interference with dichloroaniline or biphenyl which coelutes with acenaphtylene.
(4) Butylbenzylphthalate – most likely a product from a manufacturing process and not the phthalate ester.

TABLE 4.7

PERCENT REMOVAL AND EPA VARIABILITY FACTORS FOR ACID COMPOUNDS

Compound	Influent			Effluent			Percent Removal
	Arithmetic Mean (ppb)	Number of Detections	EPA Variability Factor (V_{EPA})	Arithmetic Mean (ppb)	Number of Detections	EPA Variability Factor (V_{EPA})	
4-chloro-3-methylphenol	ND	0	-	10	2	3.83	-
2-chlorophenol	107	57	7.79	63	23	6.93	41
2,4-dichlorophenol	465	43	4.42	42	33	6.73	91
2,4-dimethylphenol	1,960	12	14.15	5	8	1.00*	100
2,4-dinitrophenol	1,460	44	8.36	228	6	11.87	84
2-nitrophenol	49	38	3.54	11	4	3.57	77
Pentachlorophenol	523	49	9.11	335	57	10.30	36
Phenol	896	137	13.17	16	55	6.01	98
2,4,6-trichlorophenol	208	89	8.03	115	72	8.31	45
All Acid Pollutants	528	469	11.38	105	260	10.66	80

NOTE: ND - not detected.

*All detections were less than 10 ppb.

effluent samples and the percent removal for each pollutant calculated using the arithmetic mean influent and effluent concentrations. It should be noted that these arithmetic mean concentrations were calculated directly from the log normal probability distribution parameters presented in Tables 4.2 through 4.4 as a matter of convenience. Thus, the arithmetic means shown in Tables 4.5 through 4.7 may not be exactly equal to the true arithmetic means calculated in the conventional manner. They depend on the goodness of fit of the log normal probability distribution to the concentration data for each pollutant. The EPA variability factor is calculated as described in Chapter 2. Multiplication of this variability factor times the arithmetic mean concentration shown for a particular toxic organic pollutant will result in the estimated maximum concentration which will be exceeded less than one percent of the time (99 percent probability level).

The data shown in Tables 4.5 through 4.7 indicate, for all practical purposes, the same results as the performance data analyzed using log normal statistics. It will be noted in comparing the results presented in Tables 4.5 through 4.7 with the data presented in Table 4.2 through 4.4 that both the percent removals and average effluent concentrations are higher when the arithmetic means are used. As discussed earlier, this phenomenon results from the weighting effect that a few high concentrations can have on the arithmetic mean when concentration data follow a log normal probability distribution. Since the influent concentrations tend to have more high values than the effluent concentrations for a specific organic pollutant, the percent removal calculated using the arithmetic means tends to be higher than the corresponding removal calculated using the geometric means. Notwithstanding these differences in both the calculated percent removal and mean effluent concentrations, both the log normal and arithmetic statistics result in the conclusion that the majority of the toxic organic pollutants are removed effectively by the biological treatment systems.

As noted earlier in this discussion, there are a considerable number of pollutants for which the number of detections in the treated effluent is significantly less than the number of detections of that pollutant in the influent. If these "no detections" are included in the data base as zero concentrations, then both the mean effluent concentrations and the percent removals for these pollutants would show higher levels of performance than those reported in Tables 4.2 through 4.7. In order to demonstrate this effect, Table 4.8 presents examples of this situation for four toxic organic pollutants in each of the three pollutant groups. As shown by these data, inclusion of zero effluent concentrations representing the situation when an influent concentration is not matched by a corresponding effluent concentration results in significant increases in the projected percent removal for these pollutants. Corresponding decreases in the mean effluent concentration for each of these pollutants also occur. Although these examples are based on the use of the arithmetic mean, the same type of situation (but less exaggerated) also would occur with respect to the geometric mean and percent removals based on the log normal statistical parameters. The effect of the inclusion of zeros in the data base, also would tend to increase the predicted effluent variability inasmuch as the high values in the data base remain but the geometric and arithmetic means will be decreased. Since samples were not collected on the weekends and the lag time between influent and effluent resulting from the hydraulic retention time is not taken into account in this analysis, it is impractical and misleading to perform this analysis on the entire data base. It must be recognized, however, that this example demonstrates a fundamental fact of the analysis presented of the five-plant study data base. All performance estimates of the removal of the toxic organic pollutants are conservatively low and actual removals and effluent quality for these pollutants is better than that summarized in Tables 4.2 through 4.7 because zero effluent concentrations corresponding to measured influent concentrations were excluded from the statistics.

There are a few other characteristics of the data base which should be noted in order to avoid confusion. In a relatively few cases, the geometric mean and/or arithmetic mean effluent concentrations are higher than the corresponding influent concentrations. This occurs only in the base/neutral group data base for the pollutants benzo(b)fluoranthene/benzo(k)fluoroanthene (isomer pair), benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, and dibenzo(a,h)anthracene. In four of the five cases (chrysene the exception), this situation arises because of two factors: (1) the geometric and arithmetic mean concentrations are low and the associated standard deviation is high; and (2) with the exception of bis(2-ethylhexyl)phthalate, there are relatively few influent and effluent samples. In the case

TABLE 4.8

EXAMPLE OF THE EFFECT OF INCLUDING "NOT DETECTED" VALUES IN THE PERFORMANCE ANALYSES

Compound	Number of Detections		Percent Removal* Excluding N.D. Values	Percent Removal* Including N.D. Values
	Influent	Effluent		
Volatile Group				
Acrylonitrile	47	3	99.4	99.9
Chlorobenzene	20	1	55.6	97.2
Tetrachloroethene	31	1	27.2	97.3
Trichloroethene	31	1	39.8	97.7
Base/Neutral Group				
Benzo(a)anthracene	10	6	56.2	73.7
Fluoranthene	19	7	83.2	93.8
Pyrene	19	10	84.1	91.6
1,2,4-trichlorobenzene	46	39	82.0	84.8
Acid Group				
2-chlorophenol	57	23	40.9	76.1
2,4-dinitrophenol	44	6	84.4	98.8
2-nitrophenol	38	4	77.4	97.6
2,4,6-trichlorophenol	89	72	44.9	55.4

NOTE: ND - not detected.

*Based on arithmetic means.

of bis(2-ethylhexyl)phthalate, there are 47 influent and 44 effluent detections and the difference in the influent and effluent geometric means is 4 ppb. If the arithmetic means are used to calculate the removal of this compound, however, high concentrations in the influent data base result in an estimated percent removal of 64.4 percent. The situation with these pollutants points out the care which must be taken in using the data for an individual organic pollutant to project treatability, effluent concentrations, and variability. In the case of chrysene, the pollutant was reported specifically as chrysene in only one effuent sample and in none of the influent samples. Because chrysene is one compound of an isomeric pair (benzo(a)anthracene the other), the data for chrysene could be included as part of the data for the isomeric pair already presented in Tables 4.3 and 4.6.

INFLUENT AND EFFLUENT VARIABILITY

The variability in effluent quality from a biological treatment system is a function of the system's operational characteristics as well as the variability in influent concentration of the pollutants to be treated. Effluent variability is extremely important in the context of the development of effluent limitations guidelines inasmuch as such limitations are established to provide maximum allowable discharges of specific pollutants during short time periods such as a day or month as opposed to using long-term average removals. These estimates of short-term variability must take into account not only the inherent variability in influent wastewater characteristics and treatment system operation, including such factors as climate, but also that variability in sampling and analysis expected for the pollutant in question. As shown by the evaluation presented in Chapter 3 of this report, analytical uncertainty probably is the most important factor in establishing the expected variability in effluent quality from a biological treatment system for organic chemicals wastewaters. The EPA variability factors for the conventional and nonconventional pollutants monitored at the five participating biological waste treatment facilities probably are close to the minimum which would be expected for these types of systems treating this type of wastewater. The reasons for this already have been stated: good climatic conditions and well designed and operated treatment facilities. In addition, the pooling of the data from various laboratories which participated in this survey has the effect of significantly reducing the variability associated with the analytical methodology. Thus, the variability factors calculated for the toxic organic pollutants, as shown in Tables 4.5 through 4.7, must be considered as being the minimum variation in effluent quality which would be expected for these types of pollutants in the effluents from these types of treatment systems.

The geometric standard deviation, which is a measure of variability, is shown for both the influent and effluent wastewaters for each group of pollutants in Tables 4.2 through 4.4. The EPA variability factors which were calculated based on these standard deviations are shown in Tables 4.5 through 4.7. As can be seen by reviewing these figures for each individual pollutant, there is wide range in calculated variability. In the influent samples, the calculated EPA variability factors range from as low as 2 to almost 15. In the effluent samples, there also is a significant range in the variability factor from as low as approximately 1 to as high as 13. As noted in the tables, an effluent variability factor of 1 was generated for pollutants for which all analyses were reported below the detection limit. As explained in Appendix B, Data Management, values below the detection limit were equated to a nominal 5 ppb. This method of quantification would generate apparent variabilities of zero for some pollutants. Excluding these cases, the lowest EPA variability factor is 2.6 for effluent samples. With respect to the effluents, the variability factors must be used with great caution as there are a large number of pollutants for which only a few samples are available, thus resulting in artificially lowered variability factors.

Because of this great divergence in the variability factors for each individual compound, the most useful approach is to examine the variability factors calculated as the average for each toxic organic pollutant group. These calculated EPA variability factors and the associated arithmetic mean concentrations are shown in Table 4.9. Review of the variability factors presented in Table 4.9 shows that there is a reduction in variability by biological treatment for both the volatile and base/neutral groups of toxic organic pollutants. In the case of the acid group of pollutants, there is essentially no reduction in variability. The data shown in Table 4.9 are interesting inasmuch as there appears to be a direct correlation in arithmetic mean effluent concentration for the toxic organic pollutants and the EPA

TABLE 4.9

VARIABILITY IN INFLUENT AND EFFLUENT
TOXIC ORGANIC POLLUTANT CONCENTRATIONS

	Influent		Effluent	
Pollutant Group	Mean Concentration* (ppb)	EPA Variability Factor**	Mean Concentration* (ppb)	EPA Variability Factor**
Volatile	5,630	14.2	11	4.9
Base/Neutral	1,220	14.7	34	8.6
Acid	528	11.4	105	10.7

NOTE: These variability factors are based on data which include multiple analyses of the same sample and thus underestimate the analytical component of variability.

*Arithmetic mean.

**99 percentile, daily basis.

variability factor. Based on ES' evaluation of the data base, the variability factors for the base/neutral and acid groups are essentially the same, whereas the very high degree of removal noted for essentially all of the volatile organic compounds during the five-plant study is reflected not only in the low arithmetic mean concentrations but also in the relatively low EPA variability factor. Again, it should be emphasized that these variability factors are considered to be significantly understated due to the pooling of the treatability data base. As has been stated previously by CMA, analytical uncertainty alone merits an EPA variability factor of at least 10 and the results of the evaluation of the analytical methodologies used during this study support that recommendation (Ref. 4.2). When the combined effects of the excellent performance of the five participants' treatment plants, the pooling of the laboratory data, and the demonstrated variability in the analytical techniques are considered, it is obvious that the EPA variability factor which should be used to compute effluent limitations guidelines on a short-term basis must be substantially higher than 10 times the arithmetic mean concentration to prevent numerous cases of reported noncompliance when, in fact, a system might be meeting the desired long-term level of performance for removal of toxic organic pollutants.

REFERENCES

4.1 Walk, Haydel, and Assoc., "Contractors Engineering Report Analysis of Organic Chemicals and Plastics and Synthetics Resins Industries — Conventional and Nonconventional Pollutant Parameters," U.S. EPA, Effluent Guidelines Division, Washington, D.C., October 30, 1981.

4.2 Engineering-Science, Inc., "A Technical Analysis of the Building Block Methodology for Effluent Limitations Guidelines," CMA, Washington, D.C., November 1980.

CHAPTER 5

INDICATOR POLLUTANT EVALUATION

EPA has advanced the concept of using selected conventional and nonconventional pollutants as indicators of the presence of toxic pollutants in treated effluents from certain industrial point-source categories. The objective of using indicator pollutants is the relative simplicity and low cost associated with the sampling and analyses for conventional and nonconventional pollutants as opposed to the sophisticated, expensive, and inaccurate analyses for the toxic pollutants. In order for this concept to be workable, there must be a reasonably strong relationship between both the presence and the treatability of the toxic pollutants of interest and the conventional and nonconventional pollutants being used as indicators. The relatively long, continuous sampling programs at each of the participating plants in the five-plant study should serve as the best test possible as to whether or not conventional and nonconventional pollutants can be used as an indicator of the effectiveness of a treatment system for removing toxic organic pollutants. This chapter examines the five-plant study base with the objective of determining the potential efficacy of the indicator approach. The possible use of selected toxic pollutants as indicators of the presence of other toxics also is evaluated.

There are three basic correlations which must exist if the indicator pollutant concept is to be practical. These relationships are as follows:

(1) the presence and quantity of toxic organic pollutants in the raw wastewaters must correlate with the presence and concentration of the indicator pollutants;

(2) the treatability of the toxic and indicator pollutants should be similar; and

(3) the effluent concentrations of the indicator pollutants should be highly correlated to the presence and concentration range of the toxic pollutants under consideration.

It already has been shown in Chapter 4 that a high level of treatment is obtained for both the conventional and nonconventional pollutants representing organic constituents and the toxic organic pollutants. Since the primary purpose of the indicator pollutant concept is to monitor the effluent from the biological treatment plants, the analysis conducted by ES centered on the third of the relationships outlined above; that is, examining whether or not there is a strong correlation between any of the conventional and nonconventional pollutants and the presence of specific toxic organic pollutants in the treated effluents from the participating plants.

The approach used to evaluate this correlation was to select specific toxic organic pollutants in the effluent from a particular participant's treatment system. The indicator pollutant concept must be evaluated on an individual treatment system basis inasmuch as the effluent data for the conventional and nonconventional pollutants and the toxic organic pollutant of interest must be paired for analysis. The major criterion used for selection of a specific toxic organic pollutant for evaluation was that it be present at a quantifiable level in the effluent samples at the participating treatment plant to be studied. This criterion is necessary because a significant number of nondetections in the data base (zero concentrations) would significantly impair correlation with the conventional and nonconventional pollutants which always are present at a finite and high (relative to the toxic organic pollutants) concentration. This restriction significantly limited the data base suitable for evaluating the indicator concept since most of the toxic organic pollutants were infrequently reported in the treated effluents. Once the toxic organic pollutants meeting this criterion were selected, correlation coefficients were calculated using the matching data pairs for the toxic pollutant and the conventional and nonconventional pollutant being tested. This correlation analysis was performed in both arithmetic and logarithmic space. Calculated correlation coefficients (based on the covariance of the two pollutants) are used to determine whether a functional relationship exists between the concentration of conventional and nonconventional pollutants in the effluent and the concentration of the toxic organic pollutant of interest. A correlation coefficient of one (1) would indicate complete dependence between the two types of pollutants. A correlation coefficient of zero (0) would indicate that there is complete independence. A negative correlation coefficient indicates an inverse relationship between the two pollutants. In the context of the analysis of the indicator concept, the negative correlation would be considered as spurious and would be essentially the same as no correlation at all.

Table 5.1 presents the results of the correlation analysis between conventional and nonconventional pollutants and the toxic organic pollutants meeting the criteria for indicator analysis as described above. As can be seen from reviewing the correlation coefficients presented in Table 5.1, any correlation between a conventional and nonconventional pollutant and a toxic organic pollutant with the exception of 2,4-dichlorophenol, probably is coincidental. This finding is consistent with other statistical studies which have been made to try to support the indicator concept (Ref. 5.1, 5.2). In the case of 2,4-dichlorophenol there are relatively high (greater than 0.90) positive correlation coefficients between the pollutant and the conventional pollutant BOD_5 and the nonconventional pollutant TOD. The number of samples, however, on which the statistics are based is limited (four samples in each case). The high correlation coefficients indicate that there may indeed be a relationship between these pollutants, but this finding would have to be substantiated with additional data.

ES believes that the results of the analysis of the five-plant study are strong confirmation that conventional and nonconventional pollutants cannot be used effectively as indicators of the presence of toxic organic pollutants in biologically treated effluents from the chemicals industry. This is not to say that in a general context, a high level of biological treatment as measured by the reduction of such pollutants as BOD_5 and COD will not consistently result in essentially complete removal of most toxic organic pollutants. This has been effectively proven by the results of this study. Rather, what this analysis of indicator pollutants suggests is that it will not be practical to assess noncompliance with an toxic organic pollutant standard by establishing limits on conventional and nonconventional pollutants. In an earlier CMA report (Ref. 5.1), it was demonstrated that the presence of toxic pollutants at concentrations greater than 100 ppb in treated biological effluents was almost totally insensitive to the concentrations of BOD_5, COD, TOC, and TSS in the treated effluents. The data presented in this earlier report combined with the data developed by the five-plant study suggest that many of the toxic organic pollutants are more readily treatable in biological treatment systems than are the wide range of organic materials

TABLE 5.1

CORRELATION COEFFICIENTS* BETWEEN TOXIC ORGANIC POLLUTANTS AND CONVENTIONAL/NONCONVENTIONAL POLLUTANT EFFLUENT CONCENTRATIONS

Toxic Organic Pollutant	Conventional/Nonconventional Pollutant				
	BOD_5	COD	TSS	TOC	TOD
Volatile					
Chloroform	0.22(39)	0.29(39)	0.36(39)	-0.07(39)	-
1,2-dichloroethane	-0.20(6)	-	0.01(6)	-0.74(6)	-
Toluene	0.36(9)	-	0.18(9)	-0.24(9)	-
Base/Neutral					
Bis(2-ethylhexyl)phthalate	-0.13(33)	-	0.15(33)	-0.37(33)	-
1,2-dichlorobenzene	-	-	0.13(11)	-	-
1,2,4-trichlorobenzene	0.11(9)	-	-0.33(18)	-0.58(9)	0.21(3)
Acid					
2-chlorophenol	-	-	0.19(11)	-	-
2,4-dichlorophenol	0.97(4)	-	0.37(13)	-0.04(4)	0.95(4)
2,4-dinitrophenol	0.27(5)	-	0.22(5)	0.21(5)	-
Pentachlorophenol	-0.06(11)	-	-0.35(25)	-0.81(11)	0.68(4)
Phenol	0.61(6)	-	0.37(15)	-0.21(6)	0.43(3)
2,4,6-trichlorophenol	0.12(28)	-	-0.32(41)	-0.12(28)	0.20(4)

NOTE: (N) = N is number of data pairs.

*Concentrations on $\log_e$ scale.

represented by the conventional and nonconventional pollutant parameters. Assuming this is the case, a wide range in allowable effluent quality for the conventional and nonconventional pollutants would still provide reasonable assurance of significant removals of toxic organic pollutants when biological treatment is used.

Another and possibly more likely approach to the indicator concept would be to select a toxic organic pollutant as an indicator of the presence of other toxic organic pollutants with similar structural stability and treatability. There are few toxic organic pollutants which are present consistently in biologically treated effluents. The base/neutral and acid group of pollutants contain the most likely candidates for an indicator pollutant relationship between two toxic pollutants with compounds being present in the treated effluent from an individual participant's plant with sufficient frequency to allow correlation analyses to be performed. The same basic correlation approach described above which was used to test the indicator concept for conventional and nonconventional pollutants versus toxic pollutants also can be applied to these toxic pollutants. The results of this correlation analysis are shown in Table 5.2.

The correlations between pentachlorophenol and 2,4,6-trichlorophenol, and phenol and 2,4,6-trichlorophenol appear to indicate a functional relationship which could be used to support an indicator approach. There are sufficient data pairs available, particularly for the former relationship, to give confidence that the removal of both compounds is closely related. On the other hand, the high correlation shown between bis (2-ethylhexyl) phthalate and 1,2,4-trichlorobenzene is considered unreliable since only three data pairs were available.

The results of the latter analysis suggest that it may be practical to develop and apply the concept of using selected toxic organic pollutants as indicators of the biological removal and effluent concentration of other, closely related, toxic organic pollutants. Clearly, however, these relationships will have to be developed on a pollutant by pollutant basis, and will probably only be successful for those toxic organic pollutants which are present in concentrations of 100 ppb or more in biological effluents - which are very few in number.

TABLE 5.2

CORRELATION COEFFICIENTS* BETWEEN TOXIC ORGANIC POLLUTANTS

Base/Neutral Group

	1,2,4-trichlorobenzene
Bis(2-ethylhexyl)phthalate	0.99(3)
1,2-dichlorobenzene	-0.22(7)

Acid Group

	2-chlorophenol	2,4-dichlorophenol	Pentachlorophenol	Phenol
2,4-dichlorophenol	0.42(9)			
Pentachlorophenol	-0.21(11)	-0.01(13)		
Phenol	0.64(7)	0.35(8)	-0.30(12)	
2,4,6-trichlorophenol	0.00(10)	0.40(12)	0.91(23)	0.76(11)

NOTE: (N) = number of data pairs.

*Concentrations on $\log_e$ scale.

The results of the evaluation of the potential usefulness of indicator pollutants are not encouraging. Clearly, the use of conventional/nonconventional pollutants as indicators of the quantitative presence of toxic organic pollutants is not practical. The data strongly suggest that significant variations in treatment system performance with respect to the removal of the conventional and nonconventional pollutants have little effect on the high degree of removal noted for the toxic organic pollutants as demonstrated in this survey. In addition, the high frequency of nondetections of specific toxic organic pollutants in the treated effluents when they occurred in the influents to the biological treatment plant hinders the development of any reliable correlation between these two different classes of pollutants. With respect to using toxic pollutants as indicators for other toxic pollutants, however, the possibility exists that a practical, functional relationship could be developed for toxic organic pollutants with similar chemical structure and treatability characteristics.

CHAPTER 6

COMPARISON WITH OTHER STUDIES

In recent years, a considerable amount of effort has been expended toward development of a data base on the treatability of toxic organic pollutants in both municipal and industrial wastewaters. Included in these evaluations have been efforts to establish the accuracy, repeatability, and reproducibility of the analytical methods used for the measurement of these pollutants. In order to place the results of the five-plant study in perspective, it is useful to compare the results presented in this report with data from other studies addressing these pollutants. Also, it is useful to compare the removals of conventional and nonconventional pollutants obtained by the five plants participating in this study with the removals of similar pollutants which have been documented for other plants in the chemicals and plastics and synthetics industry. This chapter presents a summary of these comparisons, using information sources with the most relevance to the objectives and results of the five-plant study. This review is not intended to be exhaustive. Its objective is to point out both the similarities and differences between this and other studies designed to elucidate the fate of toxic organic pollutants in biological wastewater treatment systems and, more specifically, in effluents from the organic chemicals industry.

ANALYTICAL CONSIDERATIONS

In 1979, the CMA sponsored an extensive statistical analysis of data pairs from EPA's screening phase program for development of effluent limitations guidelines for the organic chemicals and plastics and synthetics industries (Ref. 6.1). Several conclusions of the CMA study are pertinent to the results of the evaluation of analytical methodology conducted for the five-plant study:

- Comparison of data from pairs of laboratories indicated a high probability of qualitative disagreement between laboratories. These disagreements represent false positive and false negative observations and the magnitude of disagreement for the combined EPA/CMA data base was approximately 50 percent when at least one laboratory detected a given compound.

- The EPA has indicated that the screening GC/MS quantitation is precise only to an order of magnitude. Statistical analyses of the EPA/CMA screening phase data base revealed a higher degree of analytical variability and uncertainty in the analytical results. Differences of two orders of magnitude between results from two different laboratories on the same sample were not uncommon.
- The determination of interlaboratory variability in the EPA/CMA data base was calculated using the EPA method which calculates the standard deviation in the natural log scale. Variability factors accounting for 95 percent of the interlaboratory variability were 14.4 and 17.4 for the liquid/-liquid extractable organics and the volatile organics, respectively.

An in-depth study of the verification phase analytical data was not conducted by CMA. However, one study did compare split samples analyzed by EPA and Dow Chemical Company laboratories (Ref. 6.2). The data base used for this comparison consisted of 1,389 data pairs including volatiles, base/neutrals, total phenols, phenolics, total cyanide, and metals. Considering the 555 data pairs for volatile organics, there was an 80.2 percent agreement on whether or not the pollutant was detected; however, the fairly high agreement was due to the fact that both laboratories reported "not detected" for 326 of the samples. The qualitative agreement was only 52 percent when examining just those samples for which at least one laboratory reported a detected value. A quantitative examination of the "false positive/false negative" portion of the volatile data base shows that Dow recorded a geometric mean of 270 ppb for samples which EPA reported "not detected" and EPA recorded a geometric mean of 70 ppb for samples which Dow reported "not detected." Even when both EPA and Dow reported a toxic organic pollutant present, there was a great deal of quantitative disagreement. The data are fairly unbiased; 55 percent of the time the EPA values were larger than the Dow values and 45 percent of the time the reverse was true. Disagreement is pronounced, however, at the extremes of the data. In fact, 10 percent of the time, Dow reported a lower value than EPA by a factor of 14 and 10 percent of the time Dow reported a higher value than EPA by a factor of 8.2. The laboratories for the influent and effluent, respectively. These analytical variability factors are considerably lower than the 23.4 variability factor observed for the liquid-liquid extractable organics measured during the screening phase study for the organic chemicals and plastics and synthetics industry. These comparisons indicate that there has been significant improvement in the precision of the analytical methodologies for measuring the toxic organic pollutants. In addition to modifications that have been made in the analytical methods, the improved analytical precision and reproducibility probably is also a result of experience that has been gained during the past several years in the application of these techniques. Notwithstanding this improvement, as shown in Chapter 3 of this report, the analytical methods still are subject to considerable variability such that quantitative use of the toxic organic pollutant data must be done with caution.

CONVENTIONAL AND NONCONVENTIONAL POLLUTANTS

The removal of conventional and nonconventional pollutants from organic chemicals industry wastewaters by biological treatment is well documented. Probably the most complete and also most recent source of such information is a report published by EPA's Effluent Guidelines Division in October of 1981 (Ref. 6.3). This report is intended to provide the technical basis for establishing effluent limitations guidelines and standards for direct and zero-discharge point sources for both the conventional and nonconventional pollutants. It represents a compilation and analysis of detailed data from 566 plants in the organic chemicals and plastics and synthetics industries which were collected as part of the effort toward development of BPT, BCT, and BAT effluent limitations guidelines.

The EPA study indicates that activated sludge is the most prevlevant biological treatment system used by the chemicals and plastics industries (72 percent of the reported biological treatment systems). A statistical analysis was conducted for EPA of the data base to determine the level of treatability provided by these biological treatment plants for wastewaters from this industry. Table 6.1 compares the median concentration for the pollutants BOD_5, COD, and TSS in the treated effluents from plants which EPA has identified as "all but plastics" with the range of mean effluent concentrations observed for these same pollutants during the five-plant participating in the five-plant study agreed 84.5 percent of the time on whether a volatile group pollutant was present or absent, 80.8 percent of the time on the acid group pollutants, and 73 percent of the time on the base/neutral pollutants. By comparison, the earlier CMA study showed laboratory agreement during the screening phase of 76.7 percent for the volatile group and 84.5 percent for the liquid-liquid extractables, which include both the acid and base/neutral pollutants as defined in the five-plant study. Most of the reason for the poorer comparability of the results from the five-plant study laboratories for the acid and base/neutral pollutants is due to the very small number of split samples analyzed and compared. The qualitative agreement between the participating laboratories in this study was of about the same order of magnitude as discussed in the Dow study of the verification phase data base and that described in the CMA study of the screening phase data base. This is a generalization of the situation, however, and a review of the data on percent agreement and detection/nondetection of pollutants in the various toxic pollutant groups by different laboratories shows considerable variation.

With respect to the interlaboratory precision of the analytical methods for the toxic organic pollutants, there seems to be a considerable improvement in technique since the screening phase study was completed. In the CMA analysis of the screening phase data base (Ref. 6.1) the analytical variability factor was calculated using the one-tailed normal distribution at the 95 percent confidence level rather than the two-tailed distribution used in this study. The one-tailed distribution understates the analytical variability factor as compared to the two-tailed distribution. To allow direct comparison of the interlaboratory analytical variability, ES adjusted the analytical variability factors in the earlier study, using the reported log normal standard deviation. The resulting analytical variability factors from the screening phase data base, calculated in this manner, are roughly twice than reported in the earlier study. The 95 percent variability factor for the volatile pollutants in the five-plant study was 6.55 for the influents and 2.61 for the effluents as compared to 30.1 observed in the earlier CMA study. In the case of the base/neutral pollutants, the corresponding analytical variablity factors are 7.24 for the influent and 5.99 for the effluent. For the acid pollutants, the variability factors are 3.38 and 4.23

TABLE 6.1

COMPARISON OF CONVENTIONAL/NONCONVENTIONAL POLLUTANT REMOVAL BY FIVE-PLANT STUDY PARTICIPANTS TO ALL PLANTS IN EPA'S ORGANIC CHEMICALS/PLASTICS DATA BASE
(Ref. 6.3)

Pollutant	Five-Plant Study Range (mg/l)	EPA Data Base Median (mg/l)*
BOD_5	3 - 19	30.5
COD	95 - 153 (3 plants)	226
TSS	10 - 65	38.5

*For all direct dischargers, except plastics category.

study. This comparison demonstrates that the performance of the biological treatment systems participating in the five-plant study was slightly better than EPA's median plants for BOD_5 and COD and probably equivalent to the median with respect to TSS concentrations in the treated effluent. As described in Chapter 4, the mean effluent concentrations actually observed at the participating plants during the five-plant study would rank them in the best 34 percent of all organic chemicals/plastics plants monitored by EPA for BOD_5, the best 45 percent for COD, and the best 79 percent for TSS. It can be concluded from this comparison that the performance of the treatment systems of each of the participants of the five-plant study closely approaches the performance of the median facility in EPA's effluent limitations guideline data base for this industry.

It is also informative to compare the performance of the plants during the five-plant study with the data collected from the 16 treatment systems used to evaluate toxic pollutant removal in the CMA building-block study (Ref. 6.4). A comparison of the median effluent concentrations for BOD_5, COD, TSS, and TOC observed for the treatment plants analyzed in the building-block study with the range of mean effluent concentrations for these pollutants measured during the five-plant study, is shown in Table 6.2. This comparison indicates that the participants' treatment systems in the five-plant study were similar to the median level of performance observed for the larger data base of organic chemicals and plastics plants used in the building-block study. This comparison supports the conclusion that the participating biological treatment plants in the five-plant study generally can be considered representative of the median level of performance obtained by biological treatment of organic chemicals industry wastewaters.

TOXIC POLLUTANTS

In the past several years, considerable data have been gathered on the treatability of the toxic organic pollutants. Proposed EPA BAT effluent limitations guidelines for the synthetic rubber, petroleum refining, and pulp and paper point-source categories conclude that biological treatment effectively removes toxic organic pollutants. A relatively substantial amount of biological treatability data were gathered by EPA for its petroleum refining guidelines and these data demonstrate effective treatment

TABLE 6.2

COMPARISON OF CONVENTIONAL/NONCONVENTIONAL POLLUTANT REMOVAL BY FIVE-PLANT STUDY PARTICIPANTS TO PARTICIPANTS IN THE CMA BUILDING BLOCK STUDY

(Ref. 6.4)

Pollutant	Five-Plant Study Range (mg/l)	Building Block Study Median (mg/l)
BOD_5	3 - 19	15
COD	95 - 153	167
TSS	10 - 65	62
TOC	23 - 60	64

of many of the toxic organic pollutants of concern to the organic chemicals industry. In addition to these data, which are part of the Effluent Guidelines Division's public record, other data have become available which demonstrate the biological removal of toxic organic pollutants. Some of the more pertinent of these data will be reviewed briefly.

An extensive study was conducted by the Municipal Environmental Research Laboratory (MERL) of EPA in Cincinnati, Ohio, into the biodegradability and rate of acclimation of biological cultures for 96 toxic organic pollutants. This study was based on the use of a static-culture-flask biodegradation screening technology which made it possible to evaluate the biodegradability of each of the pollutants tested at two concentrations (5 and 10 mg/l) by wastewater microbiota using culture enrichment techniques. A number of the pollutants analyzed in this EPA study were present in the influents and effluents of the participants in the five-plant study. Table 6.3 presents a comparison of the results of the biodegradability testing conducted by the MERL and the results of the five-plant study. The MERL study involved, as discussed above, the use of two concentrations of the toxic organic pollutant and four separate phases of biological cultural enrichment. For the purposes of the comparison in Table 6.3, the percent degradation observed by EPA in the third subculture at the 5 mg/l concentration was used. The reason for selecting the 5 mg/l concentration is that this more closely approached the concentrations observed in the influents to the treatment systems participating in the five-plant study. As can be seen by reviewing the data presented in Table 6.3, there is generally close comparison between the results of the five-plant study and EPA's estimate of the biodegradability of the toxic organic pollutants. In most cases where there is a significant difference between the calculated percent removal from the five-plant study and EPA's estimated biodegradability, it is due to the fact that the influent concentration observed during the five-plant study was less than 40 ppb, which is approaching the effective detection limit of the analytical methods used. It also should be pointed out that EPA states that the analytical method which was used in this biodegradation testing had an effective limit of detection of 100 ppb, considerably above the detection limit attained by the laboratories participating in the five-plant study. Thus, essentially all of the percent removals below 90 shown for the five-plant study probably would have been shown as a 100 percent removal by MERL's biodegradability test.

TABLE 6.3

COMPARISON OF BIODEGRADABILITY OF TOXIC ORGANIC POLLUTANTS AS PREDICTED BY EPA MERL STUDY TO THE FIVE-PLANT STUDY RESULTS (Ref. 6.5)

Volatile Compound	EPA Percent Degradation	Five-Plant Study Percent Removal**	Base/Neutral Compound	EPA Percent Degradation	Five-Plant Study Percent Removal**	Acid Compound	EPA Percent Degradation	Five-Plant Study Percent Removal**
Acrylonitrile	100	99	Acenaphthene	100	95	2-chlorophenol	100	41
Benzene	100	100	Acenaphthylene	98	93	2,4-dichlorophenol	100	91
Bromomethane	48	100	Anthracene	92	97	2,4-dimethylphenol	100	100
Bromodichloromethane	67	89	Benzo(a)anthracene	35	56***	2,4-dinitrophenol	100	84
Carbon tetrachloride	100	100	Benzo(b)fluoranthene	100	- ***	2-nitrophenol	100	77
Chlorobenzene	100	56***	Benzo(a)pyrene	NA	- ***	Pentachlorophenol	100	36
Chloroethane	NA	91	Bis(2-ethylhexyl)phthalate	95	64	Phenol	100	98
Chloroform	100	99	Butylbenzylphthalate	100	87***	2,4,6-trichlorophenol	100	45
Dibromochloromethane	55	100	Dibenzo(a,h)anthracene	NA	- ***			
1,1-dichloroethane	100	79***	Di-n-butylphthalate	100	99			
1,2-dichloroethane	100	99	1,3-dichlorobenzene	35	100***			
1,1-dichloroethene	100	100	1,2-dichlorobenzene	29	94			
t-1,2-dichloroethene	100	98	Diethylphthalate	100	99			
1,2-dichloropropane	92	97	Dimethylphthalate	100	99			
1,3-dichloropropene	100	98	Dioctylphthalate	94	90			
Ethylbenzene	100	99	Fluoranthene	100	83***			
Methylene chloride	100	75	Fluorene	77	93			
1,1,2,2-tetrachloroethane	36	93	Isophorone	100	100			
Tetrachloroethene	100	27***	Naphthalene	100	100			
1,1,1-trichloroethane	100	38***	Nitrobenzene	100	98			
1,1,2-trichloroethane	59	72***	Pyrene	100	84***			
Trichloroethene	100	40***	1,2,4-trichlorobenzene	24	82			
Toluene	100	100						
Vinyl chloride	NA†	100						

*Includes volatilization losses at 25°C and initial concentration of 5 mg/l.

**Based on arithmetic means.

***Influent concentration less than 40 ppb.

†NA = not available.

The EPA MERL study indicates that the majority of the priority pollutants are biodegradable and is confirmed by the findings of the five-plant study. Comparison of these two data bases, both of which are extensive and well documented, leads to the conclusion that the majority of these pollutants are biodegradable and a well designed and well operated biological treatment system is effective in their removal to concentrations which are below detection limits or are near the limit of determinability.

Another EPA study which provides useful information for comparison with the toxic pollutant results from the five-plant study is one performed to determine the fate of the priority pollutants in publicly-owned treatment works (POTWs). Table 6.4 presents a comparison of the toxic organic pollutant removals measured in selected POTWs with the removal of the same pollutants demonstrated during the five-plant study. The data base from the POTW toxic pollutant removal study selected for this comparison was for secondary treatment plants for which there were more than 10 data points and the influent concentrations were greater than 10 ppb. This comparison again illustrates that the levels of treatment for toxic organic pollutants by biological treatment plants are comparable for plants treating organic chemical wastewaters as represented by the participants in the five-plant study or POTWs receiving industrial wastes. The pollutants for which low removals are shown during the five-plant study are those which were measured at influent concentrations less than 10 ppb and thus are not directly comparable with the removal shown by the POTWs. The POTW data collected by EPA strengthens the conclusion that biological treatment is effective in reducing the toxic organic pollutants present in any type of biologically treatable wastewater.

Another source of information on the removal of toxic pollutants by biological treatment of organic chemical industry wastewaters is the building-block study conducted by CMA in 1980 (Ref. 6.4). In this study, verification phase toxic organic pollutant data from 16 biological wastewater treatment plants were analyzed and it was demonstrated that a high degree of efficiency in removing these pollutants was obtained. Because of the analytical uncertainty and the relatively small number of data points available for each treatment system, the data were presented by concentration ranges rather than as individual quantitative values. Table 6.5 presents a

TABLE 6.4

COMPARISON OF TOXIC ORGANIC POLLUTANT REMOVALS IN POTWs WITH FIVE-PLANT STUDY (Ref. 6.6)

Pollutant	POTW Percent Removals*	Five-Plant Study Percent Removals**
Volatile		
Ethylbenzene	89	99
Methylene chloride	55	75
Tetrachloroethene	86	27***
1,1,1-trichloroethane	88	38***
Trichloroethene	90	40***
Toluene	94	100
Base/Neutral		
Bis(2-ethylhexyl)phthalate	60	64

*Secondary treatment plants, greater than 10 data points and influent concentration greater than 10 ppb.

**Based on arithmetic means.

***Influent concentration less than 10 ppb.

TABLE 6.5

COMPARISON OF TOXIC ORGANIC POLLUTANTS FOUND IN CMA BUILDING BLOCK STUDY TREATED EFFLUENTS TO RESULTS OF FIVE-PLANT STUDY FOR THE SAME POLLUTANTS
(Ref. 6.4)

Pollutant	Number of Effluent Samples >100 ppb in Building Block Data Base*	Effluent Concentrations from Five-Plant Study	
		Arithmetic Mean	99th Percentile**
Volatile			
Benzene	3	8	32
1,2-dichloroethane	4	15	97
1,2-dichloropropane	1	8	28
Ethylbenzene	3	5	-***
Methylene chloride	3	13	69
Tetrachloroethene	2	5	-***
Toluene	3	10	46
Vinyl chloride	1	0	-***
Base/Neutral			
Bis(2-chloroethyl)ether	1	ND†	ND†
Bis(2-chloroisopropyl)ether	4	ND†	ND†
Bis(2-ethylhexyl)phthalate	2	73	701
Acid			
Phenol	2	16	96
2,4,6-trichlorophenol	1	115	954

*Sum of EPA verification phase and company data bases.

**Calculated as the product of the arithmetic mean and EPA variability factor.

***Only one effluent data point.

†Not detected.

comparison of the five-plant study data for those toxic organic pollutants which were measured in the effluents from the 16 biological treatment plants which participated in the CMA building-block study and which were measured at concentrations in the effluent greater than 100 ppb. The number of effluent samples in which concentrations greater than 100 ppb were measured is presented in Table 6.5 and is compared with both the arithmetic mean and the 99 percentile concentration for the corresponding toxic organic pollutants measured during the five-plant study. These comparisons show that with the exception of two pollutants, bis (2-ethylhexyl) phthalate and 2,4,6-trichlorophenol, the concentrations of the toxic organic pollutants which were measured at levels higher than 100 ppb in the 16 verification phase plants analyzed for the building-block study were much lower when measured for the continuous, noncurrent sampling period used at each of the participating plants during the five-plant study. In fact, in all cases, the 99 percentile concentration for all but these two pollutants was less than the 100 ppb concentration used as the cut-off in the building-block study. It cannot be determined whether this much lower concentration is due to operating characteristics of the treatment facilities or simply to the analytical variability associated with the few samples collected during the verification phase surveys at each of the 16 biological treatment plants.

Given the degree of precision and accuracy of the toxic pollutant analytical methodologies, the pollutants bis (2-ethylhexyl) phthalate and 2,4,6-trichlorophenol represent two of the very few toxic organic pollutants which appear to remain at significant residual concentrations after biological treatment. Both of these pollutants had significantly lower reductions through biological treatment than did most of the other pollutants observed during this study. In addition, there were a large number of influent and effluent data points, making this prediction reasonably reliable.

There are numerous other sources of information on the removal of toxic organic pollutants during biological treatment which have been published recently. Most of these are EPA studies or EPA-supported studies and support the conclusions which have been presented here. That is, biological treatment effectively removes most of the toxic organic pollutants (Ref. 6.7, 6.8).

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CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

As described in this report, an extensive evaluation has been made of the data base developed from a cooperative effluent monitoring agreement between EPA, CMA, and five CMA member companies. The study was structured to develop a long-term data base on the removal of toxic pollutants by biological treatment. Specific attention was given to selection of the participating plants to provide a wide coverage of toxic pollutants and treatment systems meeting EPA's definition of BPT. The study included an extensive quality control/quality assurance program to assure that the data base collected represented the best application of the analytical techniques used and to allow determination of the accuracy, repeatability, and reproducibility of the test procedures used to measure the toxic organic pollutants during this study. Three major objectives of the study, as stated in Chapter 2, were as follows:

(1) Determine the efficiency of biological treatment for the removal of toxic organic pollutants in wastewaters from the organic chemicals industry.

(2) Define the analytical reliability of the techniques used to measure the toxic organic pollutants in chemical industry wastewaters.

(3) Evaluate the potential success of using conventional, nonconventional, or selected toxic organic pollutants as indicators of the removal of all toxic organic pollutants in a particular wastewater by biological treatment.

Based on the results of the evaluation of the five-plant study data base, ES has drawn the following conclusions relevant to each of these objectives and has made recommendations as to how the results of the five-plant study can be used to reflect the real world complexity of preparing effluent limitations guidelines for toxic organic pollutants in wastewaters from the organic chemicals industry.

CONCLUSIONS

Based on the results of this evaluation, the following conclusions can be drawn:

(1) Biological wastewater treatment, as practiced by the participants in the five-plant study, removes toxic organic pollutants in all groups, with few exceptions, to effluent concentrations close to or below the accepted detection limit (10 ppb) for the analytical methodologies used in this study. This is in agreement with the proposed BAT effluent limitations guidelines for the petroleum refining industry (44 FR 75926) and the synthetic rubber industry (44 FR 75016) which acknowledge that many toxic pollutants are receiving adequate treatment in existing biological treatment systems. The results of the five-plant study, which is the most comprehensive, long-term data base for the toxic organic pollutants, indicate that BPT treatment systems in the organic chemicals industry achieve substantial compliance with the toxic pollutant control objectives of the Clean Water Act of 1977. This finding indicates that BAT for most toxic pollutants found in wastewater from the organic chemicals industry should be equivalent to the BPT biological treatment systems requirements currently installed. Evaluation of the five-plant study data base also indicates that:

- The five treatment plants, which were activated sludge units, are representative of typical BPT treatment for the organic chemicals industry in terms of the removal of conventional and nonconventional pollutants found in these wastewaters.
- The five-plant study data base does not include biological treatment system operation during cold-weather periods and thus the conventional and nonconventional pollutant removals observed at the treatment systems during the study might be higher than would be expected on an annual average basis. An earlier CMA study

indicated, however, that performance of biological treatment systems in terms of conventional and nonconventional pollutant removal, whether caused by climate or operational changes, did not have a demonstrable effect upon the removal of the toxic organic pollutants.

- The long-term average concentrations for toxic organic pollutants in the biologically treated effluents analyzed during the five-plant study are at the limit of the accuracy, repeatability, and reproducibility of the analytical methods used to determine their presence.
- Most of the toxic organic pollutants in the treatment system influents were detected more than twice as often than in the effluents.
- Comparison of the toxic organic pollutant biological treatability results from the five-plant study with similar studies supports the contention that biological treatment will remove the toxic organic pollutants to very low levels. The body of technical evidence on the removal of toxic organic pollutants in biological treatment systems is consistent with the results of this study.
- Although consistent, very high removal of toxic organic pollutants by biological treatment has been demonstrated, effluent variability factors for specific pollutants will need to be high to incorporate the significant sampling, analytical, and process variability observed during this study. The effluent variability as defined by the EPA variability factors in this report is understated. This is because the pooling of the data base representing multiple analyses of the same samples significantly reduces analytical uncertainty.
- Only two toxic organic pollutants, pentachlorophenol and 2,4,6-trichlorophenol, appear to be present in the biologically treated effluents at concentrations significantly above detection limits. This finding is not

completely consistent with other studies which show that both of these compounds can be biologically degraded almost completely.

- Based on ES's experience, there is no reason to believe that other forms of biological waste treatment would not be equally successful in removing the toxic organic pollutants as is the activated sludge process used by the participants in the five-plant study. The earlier CMA building-block study demonstrated that there was no significant difference in terms of removal of toxic organic pollutants between activated sludge and other types of biological treatment systems.

(2) Evaluation of the analytical uncertainty associated with the samples collected and analyzed during the five-plant study has demonstrated that intralaboratory and interlaboratory uncertainty remains a dominant factor in regulating toxic organic pollutants in wastewater discharges. The large number of influent and effluent samples collected during the five-plant study as well as the extensive analytical quality control and quality assurance programs which were part of the data collection effort make the results far more reliable as a basis for predicting treatment system performance and therefore, concentrations of toxic organic pollutants, than any other data base available for the organic chemicals industry. Notwithstanding this, caution must be used in assigning quantitative values to concentrations of individual pollutants measured in the influents and effluents of the participating biological treatment systems. The extensiveness of the five-plant study data base moderates but does not eliminate the inherent analytical uncertainty associated with the toxic organic pollutant test procedures. Specific findings of the evaluation include:

- The intralaboratory precision of a single measurement is quite low, even in qualified, experienced laboratories.

Analytical repeatability factors at the 95 percent confidence level ranged from 3.2 to 4.3 for treated effluents. The Range of Duplicates Factor ranged from 5.1 to 7.8 at the same confidence level and for all pollutant groups taken as a whole in treated effluents. The intralaboratory precision demonstrated during this study is particularly significant in the context of determining compliance or noncompliance at a particular plant with an NPDES Permit limitation on an toxic organic pollutant.

- The interlaboratory precision demonstrated by all laboratories participating in the five-plant study also was low, but was much better than that observed during the EPA screening phase sampling for the organic chemicals industry. The evaluation of the five-plant study data base showed no significant interlaboratory bias and the analytical reproducibility between laboratories was much improved over the earlier data base. The Range in Duplicate Factors (between laboratories) varied from 3.9 to 16.4 at the 95 percent confidence level for all influent and effluent samples in all pollutant groups measured during this study. The interlaboratory analytical reproducibility was low during the five-plant study but was approximately one-half of the levels observed during the screening phase data collection effort.
- The comparison of interlaboratory performance on a qualitative basis; that is, the chances of one laboratory reporting detection of an toxic organic pollutant in a sample when a second laboratory does not and vice versa was about the same as observed during the EPA screening phase studies. The analysis of the five-plant study data base indicates that there still is a significant probability of disagreement between laboratories on whether or not a particular organic pollutant is present in a

specific sample. This again impacts heavily on the utility of these analytical procedures for determining compliance or noncompliance with an NPDES Permit.

- The accuracy of the analytical methods can be determined from the five-plant study data base by evaluating the recovery from fortified samples and samples in which data for deuterated surrogates or internal standards were reported. In general, analysis of these data indicated highly variable recovery, suggesting that a relatively poor level of accuracy still exists in the analytical methods used for measuring toxic organic pollutants in wastewaters. The poor results from the recovery tests do not support use of EPA's method of recovery correction to improve the analytical reliability of these methods.
- The five-plant study data base is satisfactory for the purposes of demonstrating treatment system performance and making broad statements about expected effluent concentrations of toxic organic pollutants from biological treatment systems in the organic chemicals industry. If the data are to be used to develop single-number effluent limitations guidelines, however, the substantial uncertainty in the measured values associated with both sampling and analytical methodologies must be recognized and compensated for. This inherent constraint on the use of the data base for the toxic organic pollutants must be recognized when using the results of the five-plant study.

(3) The concept of using a conventional and/or nonconventional pollutant or pollutants as indicators of the presence and treatability of toxic organic pollutants is not supported by the five-plant study data base. Specific results of the analysis of the five-plant study data base relative to indicator pollutants demonstrated the following:

- No firm relationship could be found between the effluent concentrations of toxic organic pollutants and the corresponding effluent concentrations of BOD_5, COD, TOC, TOD, and TSS. This finding is consistent with the earlier CMA study conducted by ES.
- The primary reason for the lack of correlation between toxic organic pollutant concentrations in biologically treated effluents and conventional and nonconventional pollutant concentrations in the same effluents is that the former frequently are removed to levels below the analytical sensitivity of the available testing procedure while the latter always are present in relatively high and measurable concentrations.
- Analysis of possible correlations between toxic organic pollutants in the treated effluent indicated that the possibility that certain similar compounds, for example, pentachlorophenol and 2,4,6-trichlorophenol might be suitable indicators of the presence of one another in biologically treated effluents. The failure of the data base to support similar relationships between other toxic organic pollutants which should have similar levels of treatability indicates that this approach is not likely to be widely successful.
- The high and consistent biological removal of essentially all toxic organic pollutants makes the success of an indicator pollutant approach problematic. The earlier CMA study on the building-block approach showed that the presence of toxic organic pollutants in biologically treated effluents was relatively insensitive to the performance of the systems as measured by the removal of conventional and nonconventional pollutants.

RECOMMENDATIONS

Based on the evaluation presented in this report and the conclusions enumerated above, ES presents the following recommendations for development of BPT, BCT, and BAT effluent limitations guidelines for the organic chemicals industry:

(1) The five-plant study data base should be used as the primary technical basis for the establishment of effluent limitations guidelines for toxic organic pollutants in treated effluents of chemical industry wastewater. The results of this study demonstrate that biological waste treatment equivalent to BPT technology for this industry provides the removal of toxic organic pollutants necessary to meet the objectives of the Clean Water Act of 1977. This data base should be given a great deal of weight in developing the effluent limitations guidelines in that it is the best and most comprehensive estimate of the long-term performance of biological treatment in removing toxic organic pollutants from wastewaters generated by the organic chemicals industry. There is also in the five-plant study data base sufficient information to assess the importance of analytical uncertainty on the development and implementation of effluent limitations guidelines for these pollutants.

(2) EPA must recognize the effect of the extreme analytical uncertainty in the methodologies used for measuring toxic organic pollutants when establishing effluent limitations guidelines. Allowances for this uncertainty will be necessary in order to assure that permit conditions for these pollutants are realistic and reflect the uncertainty associated with a single analytical result on a specific wastewater sample.

(3) EPA should develop a BPT, BCT, and BAT effluent limitations guidelines approach for the organic chemicals and plastics and synthetics industries which allows plant-by-plant development of NPDES permit limitations. ES believes that this approach

is the only practical one to regulate toxic organic pollutants in this industrial sector, particularly in light of the difficulties in following a building-block approach as were discussed in the earlier CMA report. The approach developed for implementation of effluent limits on toxic organic pollutants must recognize the demonstrated high removal level of these compounds in biological treatment systems, and the analytical uncertainty associated with measuring the low levels of toxic organic pollutants in treated effluents. The approach must also recognize the resulting high degree of total effluent variability for the toxic organic pollutants in treated effluents which must be accounted for in NPDES permit limitations for these pollutants.

(4) The five-plant study data base should be used by EPA to develop technical guidance documentation to assist permit writers in evaluating treatability data and influent and effluent quality data for individual manufacturing plants in the organic chemicals industry. ES believes that this study provides a comprehensive and reliable data base which will allow preparation of documentation that would give guidelines to federal and state permit writers with respect to defining what constitutes acceptable levels of treatment for toxic organic pollutants. This technical guidance document would be used as described in the CMA building-block study report in order to allow realistic and equitable permit limitations to be written for plants in this industry while assuring protection of the environment.

(5) EPA should discard the concept of using conventional and nonconventional pollutants as indicators of the presence of toxic organic pollutants in the treated effluents from the organic chemicals industry. If it is desired to use the concept of indicator pollutants for controlling toxic organic pollutants in treated effluents, EPA should use specific toxic organic pollutants which correlate well with the removal of other pollutants of similar treatability and chemical structure. The results of the five-plant study demonstrate,

however, that most toxic organic pollutants are removed to a concentration at or below the analytical detection limits most of the time. Consequently, it will be difficult to develop a sufficiently large data base to demonstrate the necessary indicator pollutant/toxic pollutant relationships.

APPENDIX A

SAMPLING PROTOCOL

ANALYTICAL METHODOLOGY

PARTICIPANT A
SAMPLING PROTOCOL

Sample Locations

Influent samples were taken from the "feed" to the biological activated sludge unit.

Effluent samples were taken from the effluent from the biological activated sludge unit.

Sampling Methodology

ISCO composite wastewater samplers were used. Samples were taken every 30 minutes in 200 milliliter volumes. These samples were then combined into 24-hour composite samples.

The samples for the determination of volatile priority pollutants were taken from a five-gallon composite container.

All samples were split and preserved on site, and returned to the company where they were refrigerated at 4°C until shipment.

Sampling Schedule

There were eight weeks of sampling with each influent and effluent sample taken four days a week, except for the eighth week when only two days of sampling were done. The sampling was done from May 11, 1981 to July 1, 1981.

Sample Distribution

One shipment of an influent and an effluent sample was made to the CMA-contract lab per week. In the sixth week, however, two shipments were made. No shipments were made in the seventh and eighth weeks.

Shipment of every sample taken was made to the EPA-contract lab.

The participant-contract lab received one influent and effluent sample for analysis in each of the second, fourth, and sixth weeks.

PARTICIPANT B
SAMPLING PROTOCOL

Sample Locations

Influent samples were composites of two streams taken at the inlet to the treatment plant, which incorporates neutralization and settling prior to the biotreating unit.

Effluent samples were taken at the outlet of the biotreating unit.

Sampling Methodology

Twenty-four-hour flow-proportional composites for conventional and nonvolatile priority pollutants were taken.

Samples for volatile organics analysis were composites of daily three grab samples taken in a 24-hour period.

Sampling Schedule

Samples were taken daily for a period of five weeks. During the second week, however, two days of sampling were missed. A total of 30 influent and 30 effluent samples were taken. Sampling was conducted from October 11 to November 11, 1981.

Sample Distribution

All samples were sent to the EPA-contract lab.

Seven influent and seven effluent samples were sent to the CMA contract lab.

No analysis was performed by the participant.

PARTICIPANT C
SAMPLING PROTOCOL

Sample Locations

Influent samples were taken from the influent stream to the biological treatment system.

Effluent samples were taken at the outfall from the biological treatment system.

Sampling Methodology

Three grab samples each of treated and untreated wastewater were taken daily at approximately eight-hour intervals. The samples were composited in the laboratory prior to analysis.

Samples were taken only for the determination of volatile priority pollutants.

Sampling Schedule

Influent and effluent samples were taken four days per week for six weeks from June 2 to July 11, 1980.

Sample Distribution

All samples were sent to the EPA-contract lab and the participant-lab.

Approximately 25 percent of the samples were sent to the CMA-contract lab. Generally, one influent/effluent set was sent each week. During the last week, two sets were sent.

PARTICIPANT D
SAMPLING PROTOCOL

Sample Locations

Influent samples were collected at the influent to the activated sludge treatment system.

Effluent samples were collected at the effluent from the activated sludge treatment system.

Sampling Methodology

The samples used for determining the extractable organic toxic pollutants were obtained using Isco automatic composite samplers equipped with two-gallon glass sample bottles. The samplers took grab samples at three-minute intervals over a 24-hour period.

Samples for determining the volatile priority pollutants were obtained by collecting grab samples three times daily at eight-hour intervals. These samples were collected in 120-milliliter, septum-sealed vials. The samples were composited by combining equal volumes of each, and resealing the composite sample in septum-sealed vials.

Sampling Schedule

Sampling was conducted five times weekly for six weeks from June 23 to August 1, 1980.

Sample Distribution

Every sample was sent to the EPA-contract lab.

One influent and one effluent sample were sent to the CMA-contract lab and participant-lab each week. During the sixth week, two samples were sent to these labs.

COMMENTS:

The samples were not refrigerated during collection.

PARTICIPANT E
SAMPLING PROTOCOL

Sample Locations

Influent samples were taken of the effluent from a pretreatment facility and the influent to the main biological treatment system (before the pH control point).

Effluent samples were taken from the biotreater effluent stream.

Sampling Methodology

Three ISCO samplers were used to collect 24-hour time-proportional composite samples.

Sampling Schedule

Six influent and six effluent samples were taken weekly for five weeks, April 12 to May 17, 1981.

Sample Distribution

All samples (30 influent, 30 effluent) were sent to the EPA-contract lab. Seven influent and seven effluent samples were sent to both the CMA-contract lab and the participant lab.

COMMENTS:

No field spiking was done and no preservatives were added.

PARTICIPANT A

ANALYTICAL METHODOLOGY*

	Laboratory		
	LAB 1	LAB 2	LAB 3**
General Methodology	GC/MS	GC/MS	• GC • GC/MS
Specific Method	• EPA Method 624 • EPA Method 625	• EPA Method 624 • EPA Method 625	• EPA Method 1625 • EPA 600 Series GC# 610 for PAH's • OCB Method 7, Variation 5 Microextraction for phenols • OCB Method 7, Variation 3 Microextraction for aromatics
Modifications	None	Influent samples analyzed by direct injection for volatiles due to high concentration of organics.	None
Interferences	None detected	High concentration of organics in some influent samples. Direct injection for these samples eliminated problems.	Non-priority pollutant compounds interfered with analysis. Interference resolved.

COMMENTS:

*As reported on analytical methodology questionaire and in analytical reports.

**Lab 3 data omitted from study. See discussion in Appendix B, "Outliers/Omission of Data."

Indistinguishable isomeric pairs (3) detected.

PARTICIPANT B

ANALYTICAL METHODOLOGY*

	Laboratory		
	LAB 1	LAB 2	LAB 3
General Methodology		GC/MS	GC
Specific Method		EPA Method 625	• EPA Method 624 • EPA Method 625 • EPA 600 Series GC# 602, 609 • OCB Method 7, Variation 5 Microextraction for phenols
Modifications	*********** Company did not analyze any samples ***********	As allowed within specific method (column SP1240DA).	• FID used in Methods 602 and 609 instead of photoionization detector. • Method 602 – column used was 1.5% SP 2250 1.95 to SP2401 1001/120 Supelcoport • Method 609 – column used was 1% SP1000 60/80 Carbopack B • Method OCB 19 – acid spikes added before base/neutral extraction.
Interferences		None	• Peaks on two acid compounds could not be cleanly resolved; minor compound could not be quantitated in majority of influent samples. • Interference peaks on several acid compounds.

*As reported on analytical methodology questionaire and in analytical reports.

PARTICIPANT C

ANALYTICAL METHODOLOGY*

	Laboratory		
	LAB 1	LAB 2	LAB 3
General Methodology	GC/MS	GC/MS	GC/MS
Specific Method	EPA Method 624	EPA Method 624	EPA Method 624
Modifications	None	As allowed within specific method.	None
Interferences	None detected	Interference experienced with influent samples. Direct injection employed for analysis of influent samples.	Detector overloaded, unless sample was diluted.

*As reported on analytical methodology questionaire and in analytical reports.

PARTICIPANT D

ANALYTICAL METHODOLOGY*

	Laboratory		
	LAB 1	LAB 2	LAB 3
General Methodology	GC/MS	GC/MS	GC/MS
Specific Method	• EPA Method 624 • EPA Method 625	• EPA Method 624 • EPA Method 625	• EPA Method 624 • EPA Method 625
Modifications	• Volatiles analyzed with packed glass column. Column at 70°C for 4 min.; program at 8°C per minute to 170°C, hold for 20 minutes. • Some samples for extractable compounds analyzed with capillary column. Column for base/neutrals at 60°C for 4 min.; program at 6°C per min. to 280°C, hold for 20 min. Column for acid at 75°C for 4 min.; program at 8°C per min. to 170°C, hold for 20 minutes. • Two volatile compounds detected by FID. Glass column at 35°C for 4 min.; program at 15°C per min. to 200°C, hold for 15 minutes.	Direct injection of some volatile compounds.	Microextraction
Interferences	• Precipitate formed in base/neutral extraction prevented complete extraction of certain compounds. • Co-elution of volatile compound with major component (not priority pollutant) of wastewater resulted in poor precision in quantification. • Co-elution of base/neutral compounds with nonpriority pollutant compounds.		

COMMENTS:

*As reported on analytical methodology questionaire and in analytical reports.

Certain compounds incompletely extracted with EPA-specified method.

PARTICIPANT E

ANALYTICAL METHODOLOGY*

	Laboratory		
	LAB 1	LAB 2	LAB 3
General Methodology	GC/MS	GC/MS	GC/FID
Specific Method	EPA Method 625	EPA Method 625	EPA 600 Series GC# 604
Modifications	• Only extraction for acid/neutral compounds performed since base/neutral extraction would have formed interfering precipitate. • Capillary column instead of packed glass column. • Inject at 35°C, hold 1 min. Program at 10°C per min. to 280°C. Injection temperature, 250°C.	• Only extraction for acid/neutral compounds performed since base/neutral extraction would have formed interfering precipitate. • Column used was SP1240DA. • 50 to 200°C at 10°C per min., hold 2 minutes.	• Only extraction for acid/neutral compounds performed since base/neutral extraction would have formed interfering precipitate. • Inject at 75°C, hold 2 min. Program at 8°C per min. to 170°C. Injection temperature, 200°C.
Interferences	Interference with sample or two; used alternate ions.	Interference (isomer) with one compound in four out of seven influent samples prevented quantification.	Peaks on two compounds not completely resolved; making quantification difficult. Interference eliminated.

*As reported on analytical methodology questionaire and in analytical reports.

APPENDIX B

DATA MANAGEMENT

This section details the methodology used in handling the laboratory data and the calculations underlying the results of the data analysis presented in the main body of this report. Also discussed are the assumptions, as well as the basis for such assumptions, as were incorporated into the data management system.

The assumption that the log normal distribution describes the treatment system influent and effluent concentration data is both a matter of convenience and a result of considerable documentation by EPA, and others, that it generally describes the probability distributions of such data. This occurs since wastewater concentration data are bounded at the lower end by zero (particularly effluent data) but have, in effect, an almost unlimited upper bound. Thus, typically, there are a few very high concentrations in a particular data set which skew the probability distribution to the extent that log normal statistics describe the concentration data better than, or at least as well as, Gaussian normal statistics.

A second assumption which was made was that the data bases for a given toxic organic pollutant from different participating plants could be pooled for statistical analysis. The primary purpose for this pooling of data was to retain confidentiality for each participant. Additionally, the data base for each pollutant in a particular influent and effluent was often very limited in size, and pooling these data often signficantly increased the size of the data base for a particular pollutant. It is recognized that the most rigorous statistical approach should include testing these assumptions on each individual data set; because of the considerations described above, ES did not perform these analyses of assumptions on all data sets, but random observations supported the overall validity of the approach taken.

The third assumption which was made was that the precision estimate for individual toxic organic pollutants could be pooled to provide an estimate of the precision for a particular pollutant group. It is obvious in the tables presented herein that some of the precision estimates for individual pollutants would not meet statistical criteria which would allow pooling of the data. Many of the pollutants had only a few observations which certainly limited the reliability of the corresponding precision estimate. By pooling the data by pollutant group, however, one significantly increases the data base and reliability of the group as a whole. The pooled precision estimate for each group is useful in that it provides a basis of comparison for individual pollutants in a group as well as comparison between pollutant groups.

OUTLIERS/OMISSION OF DATA

None of the data were omitted from data calculations because they would have been considered outliers by statistical standards.

In the data, there was evidence that some pollutants had been misidentified, but were nonetheless reported. Evidence to support this belief came from the participants, whose laboratories were more familiar with their wastewaters and manufacturing processes. None of these data, however, was edited or omitted from the data analyses, thereby giving each laboratory equal weight with respect to data validity. The data for which there was reasonable doubt as to true identification in some of the analyses included: (1) 1,2,4-trichlorobenzene – most likely the co-isomer, 2,4,6-trichlorobenzene, which is not on the priority pollutant list; (2) diethylphthalate – interference from dimethylnitroaniline, which coelutes with the phthalate ester; (3) acenaphthylene – interference from dichloroaniline or biphenyl which coelutes with acenaphthylene; and (4) butylbenzylphthalate – most likely a product from a manufacturing process.

One entire set of laboratory data was not included in the scope of this study. This data set was from the EPA contract lab for Participant A. The EPA contract lab reported interference problems in the analysis of the samples, and reported that these data should not be considered valid. The EPA contract lab then froze the remaining portions of the samples intending to rerun the analysis after the interferences were resolved. The time between the sample collection period (July 1981) and the initiation of the second set of analyses (December 1981) was so long as to jeopardize the integrity of the samples based on EPA recommendations (44 FR 75051, December 18, 1979).

QUANTIFICATION OF QUALITATIVE VALUES

Some of the results of the laboratory analyses were reported as concentrations less-than or greater-than a specified numerical value. The less-than values were reported largely in the effluent wastewater samples and reflected the analytical limitations of detection and quantification of a compound at very low concentrations. Greater-than values were reported in several of the influent samples in which concentrations were so high as to overload the detector. In addition to the less-than and greater-than values which were reported, some compounds which were detected could not be quantified at all due to analytical interferences.

A concentration of 10 ppb was chosen as the detection limit for all laboratory analyses. It is understood that the actual detection limit will vary by compound and degree of analytical capabilities; however, a detection limit of 10 ppb is not an unreasonable assumption for the toxic organic pollutants. It also is the level of detection assigned to most of the organic toxic pollutants for EPA's analytical methods (44 FR 69464). All values reported as less than 10 ppb were given a numerical value equal to five ppb. By doing this, one is assuming that all concentrations less than 10 ppb follow a normal distribution with a mean equal to five ppb. The choice of distribution, although arbitrary, does not affect the conclusions reached in this study; therefore, the simple normal distribution was chosen. All less-than data within this study, as it were, were reported at numerical limits less than the predetermined detection limit of 10 ppb.

Greater-than values were handled in two different manners for data analysis. For the purposes of calculating the mean concentration of a pollutant in the entire set of influent samples (greater-than values were reported only in influent samples), greater than concentrations were set equal to the greater-than value. For example, benzene reported as >5,500 ppb, was set equal to 5,500 ppb. The mean influent concentrations of the toxic organic pollutants as compared to the mean concentration of the effluent samples were used to define the treatability of the pollutant. The effect of the above method of quantification for greater-than values in the influent samples is to lower the overall mean concentration and in turn, lower the apparent removal (treatability) efficiency. The conservatism of this approach was the reason for using this methodology. The second manner of handling greater-than data was used in the calculations of interlaboratory (between laboratories) and intralaboratory (within laboratories) precision. In these calculations, the greater-than values were omitted. If the data had been included, the precision estimate (standard deviation) could have been biased on the low side, underestimating the true analytical variability. Greater-than data are indicated as such in the raw data appendix (Appendix D).

Concentrations which could not be quantified due to analytical interference were not used in any of the data analyses which were based on concentrations. The pollutants which could not be quantified were marked as detected, however, to be used in the calculations for qualitative agreement (whether a pollutant was detected/nondetected by laboratories analyzing a common sample) among laboratories.

ACCURACY — SPIKE RECOVERY

Analytical accuracy was determined from the recovered percentage of spikes for toxic organic pollutants, surrogate compounds and internal standards. The percent recovery, %R, relative to a sample fortified by or spiked at a known concentration is calculated by the following equation:

$$\%R = 100\% \times \frac{C_{ss} - C_{us}}{C_{sp}} \qquad \text{(equation 1)}$$

where C_{ss} $\equiv$ measured concentration of fortified or spiked sample

C_{us} $\equiv$ measured concentration of original sample

C_{sp} $\equiv$ spike concentration (increase in concentration due to spike)

Based on equation 1, the percent recovery can be negative if the concentration by analysis of the fortified or spiked sample is less than the analytical value of the original sample. The common practice of all the laboratories in this study which reported recovery percentages was to equate all negative recoveries to zero, presuming that one can only lose up to 100 percent of the spike. It is believed, however, that negative recoveries are true numbers, and both reflect and emphasize the variability in laboratory accuracy. Calculated recoveries which were negative were not equated to zero in this study.

Mean percent recoveries were calculated as arithmetic means in the normal manner for each priority pollutant, surrogate compound, and internal standard. Correlation coefficients also were calculated between percent recovery for the toxic organic pollutants and spike concentration to determine the dependence, if any, between these two parameters. The correlation coefficients were calculated on both arithmetic and log-scale. Because some of the recoveries were negative, only the spike concentration could be transformed to log-scale. The basis for calculating the correlation coefficients were then (1) arithmetic (recovery) - arithmetic (spike) scale, and (2) arithmetic (recovery) - log (spike) scale. The equations for calculating correlation coefficients, c, are:

(1) Arithmetic (recovery) — Arithmetic (spike) scale

$$c = \frac{\sum_{i=1}^{n} (r_i - \bar{r})(p_i - \bar{p})}{(n - 1)\, s_r s_p} \qquad \text{(equation 2)}$$

(2) Arithmetic (recovery) — Log_e (spike) scale

$$c = \frac{\sum_{i=1}^{n} (r_i - \bar{r})(\ln p_i - \bar{p}_{ln})}{(n - 1)\, s_r s_{pl}} \qquad \text{(equation 3)}$$

where $\bar{r}$ ≡ mean percent recovery

$\bar{p}$ ≡ mean spike concentration (arithmetic scale)

$\bar{p}_{ln}$ ≡ mean spike concentration ($\log_e$ scale)

s_r ≡ standard deviation with respect to $\bar{r}$

s_p ≡ standard deviation with respect to $\bar{p}$

s_{pl} ≡ standard deviation with respect to $\bar{p}_{ln}$

n ≡ number of recovery - spike data pairs

Correlation coefficients calculated as above indicated that neither arithmetic nor log-scale for spike concentration gave consistently higher or lower correlation values. The coefficients also indicated that very few toxic organic pollutants displayed relationships between recoveries and spike concentration. None of the pollutants displayed very strong relationships between recoveries and spikes (correlation coefficients greater than 0.7). Because recovery did not appear to be strongly related to spike concentration for individual pollutants, the data were pooled for pollutant groups (volatile, base/neutral, acid) in order to calculate the overall mean percent recovery for a particular pollutant group.

QUALITATIVE COMPARISON OF LABORATORIES

Qualitative comparison of laboratories refers to the percentage of time that laboratories analyzing the same sample agree and disagree on the detection and nondetection of specific pollutants. Wastewater samples from the five participants in this study were not analyzed for all 88 (including the three delisted pollutants) toxic organic pollutants. Within the laboratories analyzing samples from a single participant, there were differences in the number of pollutants for which analysis was conducted. Therefore, qualitative comparisons for each participant were based only on the pollutants which were common to the laboratories being compared.

There are several items to note about the method which was used to calculate qualitative percentage agreement among laboratories. One, as noted in the preceding sections, pollutants which could not be quantified because of analytical interferences were counted as detections for the qualitative comparisons. Two, with replicate analyses, if one of the analyses for a particular pollutant was reported as a nondetection and the other as a detection, the pollutant was counted as detected. Three, cis-1,3-dichloropropene and trans-1,3-dichloropropene data were added to represent total 1,3-dichloropropene. Four, eight base/neutral compounds were reported consistently, with one exception, as four indistinguishable isomeric pairs. These pairs are: (1) 1,3-dichlorobenzene and 1,4-dichlorobenzene; (2) anthracene and phenanthrene; (3) benzo(a)anthracene and chrysene; and (4) benzo(b)fluoranthene and benzo(k)fluoranthene. The one exception was chrysene, which was reported in some analyses as the single compound, and not the isomer pair benzo(a)anthracene/chrysene. For qualitative comparative purposes, however, the four isomer pairs were used instead of the eight individual pollutants. This effectively shortened by four compounds the base/neutral pollutant list used in calculations for qualitative agreement and disagreement percentages.

An example of how the qualitative comparison calculations (percent agreement and percent disagreement) were made is given here: Three laboratories analyzed the same 12 wastewater samples for 30 toxic organic pollutants. There were then 360 (12 x 30) individual analytical results from one lab, including any nondetections. Out of 360 analytical results, there are 270 results from each laboratory in which all three laboratories agreed in their findings that the pollutant was detected or nondetected. Of the 270 agreements, 90 were detections reported by all the labs, and 180 were nondetections reported by all labs. The percentage agreement based on detection of the pollutants was 25 percent (100% x 90/360); based on nondetections, the agreement was 50 percent (100% x 180/360). The overall agreement based on detections and nondetections was then 75 percent (25% plus 50%). In the remaining 90 analytical results, the laboratories disagree in their findings; that is, one laboratory detected a pollutant while the others did not, or vice versa. The percent disagreement is 25 percent (100% x 90/360). Although this example is given for comparison of three laboratories together, comparisons between two laboratories at a time were performed in the manner just described.

An additional comparison can be made between laboratories based on the qualitative data. This comparison is based only on the times when at least one laboratory detected a pollutant in a sample. Comparisons of this nature indicate the probability of occurrence in which one or two laboratories will detect a pollutant while the other laboratory(s) will not. For instance, taking the above example, 25 percent of the time all three laboratories agreed that a pollutant was found. On the other hand, 25 percent of the time the laboratories did not agree on the presence of a specific pollutant; that is, one or two of the laboratories reported the same pollutant while the other two (or one) did not. Fifty percent of the time (25% plus 25%), a pollutant was detected by at least one laboratory; however, this indicates that when this occurs, there will be one chance in two (25% out of 50%) that the other laboratory(s) will not detect the same pollutant.

INTERLABORATORY PRECISION

Interlaboratory (between laboratories) precision was calculated on $\log_e$ scale for each pollutant group as a pooled estimate from the individual pollutants within the group. Only the data from samples in which all the laboratories being compared detected a particular pollutant were used. If any of the reported concentrations were greater-than values, the data pair or data set (concentrations from three laboratories) was not used in the calculation so as not to bias the precision estimate on the low side. Precision calculations were made on a one-to-one basis (between two laboratories) for all the possible combinations (3) of the three laboratory categories (EPA-, CMA-, Participant-contract) for each participant. Precision calculations also were made based on all the laboratories for each participant's wastewater, when all laboratories detected a particular pollutant.

The calculation for precision for the log normal distribution (standard deviation, s) between values from two laboratories (a, b) is as follows:

$$s = \frac{|\ln(a/b)|}{\sqrt{2}} \qquad \text{(equation 4)}$$

The pooled standard deviation, s_p, for all pollutants within a pollutant group is calculated by the following equation:

$$s_p = \left[\frac{1}{n} \sum_{i=1}^{n} s_i^2\right]^{0.5} \qquad \text{(equation 5)}$$

where s_i ≡ the standard deviation for a data pair i as calculated by equation 2

n ≡ number of data pairs

By pooling the individual standard deviations in this way, the assumption is made that the population variances of the data pairs are, to an adequate approximation, equal, and the individual sample standard deviations may be pooled to provide an estimate of the true population standard deviation. This is saying in effect, that interlaboratory error (precision) is independent of concentration and specific pollutant. The data were pooled for two reasons: (1) to maintain the confidentiality of each participant; and (2) to increase the number of individual values in the data base for each pollutant. Ideally, before such pooling is done, each data set for each pollutant should be tested to demonstrate that they came from the same population; this was not done in this study since the pooling was mandatory to provide anonymity to the sources.

Interlaboratory precision between two laboratories was displayed graphically in this report in Figures 3.1 and 3.2. In these figures, the individual data pairs for two laboratories being compared are plotted as one laboratory versus the other on two-dimensional graphs. The interlaboratory precision is reflected on the graph as the 95 percent confidence interval for Range of Duplicates (interlaboratory). Range of Duplicates (interlaboratory) is defined in this report as the 95 percent confidence interval of the range into which the single value found by a second analysis in a second laboratory is expected to fall based on the value found by a single analysis in the first laboratory.

The variance (V) related to the difference between two values (a, b) with the same standard deviation(s) is:

$$V(a-b) = 2s^2 \qquad \text{(equation 6)}$$

Therefore, the standard deviation related to the difference between two values is $\sqrt{2}$ s. The Range of Duplicate Factors (interlaboratory, 95 percent confidence limits), R_U and R_L respectively, are defined as follows:

$$R_U = \exp\,(1.96\sqrt{2}\ s) \qquad \text{(equation 7)}$$

$$R_L = \exp\,(-1.96\sqrt{2}\ s) \qquad \text{(equation 8)}$$

where 1.96 $\equiv$ value of Student's t distribution at the 2.5 percent probability level (two-tailed distribution for 95 percent confidence interval), assuming the number of degrees of freedom approaches infinity.

Range of Duplicates Factors (interlaboratory, 95 percent confidence level) (R_U and R_L) are used in this study to define the range of values into which a second determination, measured in another laboratory than the laboratory in which the first determination was made, is expected to fall. For example, if the interlaboratory precision has been estimated to be 0.880 (pooled standard deviation), R_L and R_U are then 0.09 and 11.46, respectively. If a single value in one laboratory is 100 ppb, a second value in any other laboratory should fall between nine ppb and 1,146 ppb. If it falls outside this range, the method may not be under statistical control in one or both laboratories.

In addition to illustrating interlaboratory precision, plots of the data pairs between laboratories are used to determine laboratory bias. In each plot, a 45-degree angle is drawn from the origin of the axes. If the scatter of the data pairs falls uniformly above and below this line, there is no apparent bias of one laboratory relative to the other. If the data points tend to lie above the 45-degree line, then, for example, Lab Y (plotted as the vertical axis) is biased on the high side in its analtyical results relative to Lab X (plotted on the horizontal axis). Conversely, if the data points lie below this line, then Lab Y is biased on the low side relative to Lab X. In these plots, laboratory bias relates to a situation where one laboratory obtains a higher value, consistently, than a second lab, not to the difference between a value found and the true value for that component in that sample.

Interlaboratory precision based on detectable concentrations from three laboratories (or two laboratories in the case of Participants A and B) for the same sample also were calculated. The standard deviation (s) for each data set (the reported concentrations, c) was calculated as follows:

$$s = \left[\frac{\sum_{i=1}^{n} (\overline{\ln c} - \ln c_i)^2}{(n - 1)} \right]^{0.5} \qquad \text{(equation 9)}$$

where $\overline{\ln c}$ ≡ mean of the natural logarithm of the concentrations

c_i ≡ concentration reported by lab i

n ≡ two or three, as applicable to each participant

Based on the same assumptions stated above for interlaboratory precision between two laboratories, the individual standard deviations calculated by equation 9 were combined to give the pooled standard deviation among laboratories.

Range of Duplicate Factors (Interlaboratory, 95 percent confidence level), R_U and R_L, can be calculated by equations 7 and 8 for the pooled interlaboratory standard deviation based on all laboratories analyzing the same sample.

Analytical Reproducibility Factors (V_U, V_L) in this study are used to define the 95 percent confidence limits of the uncertainty of a single value for a concentration of a toxic organic pollutant. V_U and V_L are defined as follows:

$$V_U = \exp(1.96\ s) \qquad \text{(equation 10)}$$

$$V_L = \exp(-1.96\ s) \qquad \text{(equation 11)}$$

where $s \equiv$ pooled interlaboratory standard deviation

For example, assume that the same sample is analyzed once in a particular laboratory by the same specified method which has been shown to have, for the same particular pollutant, an interlaboratory precision (pooled standard deviation) of 0.880. Again, the value found was 100 ppb. Based on this interlaboratory (between laboratories) precision estimate, the upper and lower analytical reproducibility factors are $V_U = 5.61$ and $V_L = 0.18$. If the analysis of this exact sample were repeated once in each of 100 laboratories 95 percent of the values found would fall between 18 ppb (0.18 x 100 ppb) and 561 ppb (5.61 x 100 ppb).

It must be noted here that V_U and V_L are not the same as the variability factor calculated by EPA methods (Ref. B.1), referred to as V_{EPA} in the study report. V_{EPA} is defined as the ratio of the 99 percentile concentration (based on the log-normal distribution) to the arithmetic mean concentration. V_U is the ratio of the upper 95 percent concentration (based on the $\log_e$-normal distribution) to the concentration found. V_L is defined similarly to V_U, using the lower 95 percent concentration. Also, V_U and V_L refer specifically to interlaboratory variability relative to the analyses of a single sample. V_{EPA} includes not only interlaboratory uncertainty but also sampling and process variability.

INTRALABORATORY PRECISION

Intralaboratory (within laboratory) precision was calculated for individual toxic organic pollutants and for each of the pollutant groups as a whole. Calculations were based on the assumption of the log-normal distribution of concentrations from replicate analyses. The intralaboratory precision (standard deviation) was calculated in the normal manner for each set of replicate analyses. (Equation 4, except that value a and value b were obtained in the same laboratory). If one of the data values in a replicate sample was reported as nondetected, or zero ppb, a value of one ppb was assigned to this analysis so that the standard deviation on log-scale could be calculated (logarithm of a negative number is not defined). A value of one ppb was chosen because together with the other non-negative replicate values, it produced standard deviations of a similar magnitude as was seen in other replicates which had all non-zero values. A value less than one ppb, for instance 0.1 ppb, tended to produce standard deviations much higher than most replicates. Replicate analyses included those samples which were scheduled to be analyzed in duplicate as well as blind replicate samples sent to some of the laboratories. Standard deviations were combined from all laboratories to provide a pooled estimate of intralaboratory variability for each pollutant and pollutant group. The pooled standard deviation (s_p) was calculated as follows:

$$s_p = \left[\frac{\sum_{i=1}^{m} s_i^2 \times n_i}{\sum_{i=1}^{m} n_i} \right]^{0.5} \qquad \text{(equation 12)}$$

where s_i ≡ standard deviation for replicate set i

n_i ≡ degrees of freedom for each replicate set i

m ≡ number of replicate sets for pollutant (or pollutant group)

Analytical Repeatability Factors (W_U, W_L) were calculated as follows:

$$W_U = \exp(1.96\, s_p) \qquad \text{(equation 13)}$$

$$W_L = \exp(-1.96\, s_p) \qquad \text{(equation 14)}$$

where s_p ≡ pooled intralaboratory standard deviation as calculated by equation 12.

Analytical Repeatability Factors (W_U, W_L) define with respect to a single laboratory, the 95 percent confidence limits (upper limit W_U, lower limit W_L) for a single value. For example, assume that an effluent sample is analyzed by a specified method which has been shown to have, for a particular pollutant, an intralaboratory precision (pooled standard deviation) of 0.187. The value found for the pollutant was 100 ppb. Based on this precision estimate, the upper and lower analytical repeatability factors are $W_U = 1.44$ and $W_L = 0.69$. If the analysis of this exact sample were repeated in the same laboratory 100 times, 95 percent of the values would fall between 69 ppb (0.69 x 100 ppb) and 144 ppb (1.44 x 100 ppb).

Range of Duplicates Factors (Intralaboratory, 95 percent confidence level) (P_U, P_L) are used in this study to define the range of values into which a second determination, made in the same laboratory is expected to fall P_U and P_L are defined in equation form as:

$$P_U = \exp(\sqrt{2} \times 1.96 \times s_p) \qquad \text{(equation 15)}$$

$$P_L = \exp(-\sqrt{2} \times 1.96 \times s_p) \qquad \text{(equation 16)}$$

If the intralaboratory precision has been estimated to be 0.187 (pooled standard deviation) P_U and P_L are then 1.68 and 0.60, respectively. If a single value in that one laboratory is 100 ppb, a second value should, 95 percent of the time, fall within 60 ppb (0.60 x 100 ppb) to 168 ppb (1.68 x 100 ppb). If it falls outside this range, the method may not be under statistical control in that laboratory.

TREATMENT SYSTEM PERFORMANCE

The geometric mean and standard deviation of the toxic organic pollutants were calculated for all influent and effluent samples based on all non-zero concentrations. With respect to replicate analyses from the same laboratory, one analytical value was arbitrarily chosen to be included in the calculations. Daily variability factors (V_{EPA}) were calculated by EPA methods (Ref. B.1). V_{EPA} is calculated as follows:

$$V_{EPA} = \exp(2.3263\ s - 0.5\ s^2) \qquad \text{(equation 17)}$$

where $s \equiv$ standard deviation, $\log_e$ scale

V_{EPA} is multiplied by the arithmetic mean, and represents the concentration which can be expected to be exceeded only one percent of the time. The arithmetic mean (M_A) can be calculated directly from the log normal statistics according to the following equation (Ref. B.2):

$$M_A = M_{ln} \exp(0.5\ s^2) \qquad \text{(equation 18)}$$

where $M_{ln} \equiv$ geometric mean

Percent removals based on influent and effluent mean concentrations were calculated for both arithmetic means and geometric means.

Influent sample concentrations for one of the participants had to be adjusted by a dilution factor to reflect a flow addition to the sampled influent system before the combined stream entered the treatment system. The additional flow was not a wastewater containing toxic organic pollutants. Its effect on influent concentration was simple dilution.

INDICATOR POLLUTANT CONCEPT

The indicator pollutant concept for effluent wastewaters was evaluated through the determination of correlation coefficients between pollutant concentrations. The indicator concept was evaluated for toxic organic: conventional/nonconventional and toxic organic: toxic organic pollutant combinations.

Correlation coefficients were calculated for arithmetic-scale and log-scale concentrations. Correlation coefficients were not calculated for all toxic organic pollutants detected in the effluent wastewaters since most of the pollutants had mean effluent concentrations below the detection limit. It was not believed that correlation coefficients based on this type of data would have much validity because of the imprecision of analyses near the detection limit. Those toxic organic pollutants for which correlation coefficients were calculated had, in general: (1) geometric mean effluent concentrations greater than the 10 ppb detection limit; (2) a relatively large number of detections; and (3) corresponding data for conventional, nonconventional, and toxic organic pollutants for the same individual sample. Correlation coefficients were calculated utilizing only those effluent concentrations greater than 10 ppb.

Neither of the two scales (arithmetic, log) gave consistently higher or lower correlation coefficients. The log-scale coefficients were arbitrarily selected for use in this report since most of the data analysis was based on log scale.

APPENDIX C

QUALITATIVE COMPARISON OF LABORATORIES ON ONE-TO-ONE BASIS BY POLLUTANT GROUP

QUALITATIVE COMPARISON OF LABORATORIES
PERCENT AGREEMENT AND DISAGREEMENT IN DETECTION/NONDETECTION OF VOLATILE TOXIC ORGANIC POLLUTANTS

	Influent Samples				Effluent Samples			
	Lab 1 vs. Lab 2	Lab 2 vs. Lab 3	Lab 1 vs. Lab 3	All Labs	Lab 1 vs. Lab 2	Lab 2 vs. Lab 3	Lab 1 vs. Lab 3	All Labs
Participant A								
Agree	94%	NA	NA	94%	92%	NA	NA	92%
Detected	11%	NA	NA	11%	3%	NA	NA	3%
Nondetected	83%	NA	NA	83%	89%	NA	NA	89%
Disagree	6%	NA	NA	6%	8%	NA	NA	8%
Number of Pollutants	30	NA	NA	30	30	NA	NA	30
Number of Samples	3	NA	NA	3	3	NA	NA	3
Participant C								
Agree	79%	86%	84%	75%	88%	82%	81%	76%
Detected	26%	28%	35%	26%	12%	16%	13%	11%
Nondetected	53%	58%	49%	49%	76%	66%	68%	65%
Disagree	21%	14%	16%	25%	12%	18%	19%	24%
Number of Pollutants	30	30	30	30	30	30	30	30
Number of Samples	6	6	24	6	6	6	24	6
Participant D								
Agree	90%	89%	89%	83%	88%	92%	96%	88%
Detected	24%	14%	18%	17%	1%	1%	1%	0%
Nondetected	66%	75%	71%	66%	87%	91%	95%	88%
Disagree	10%	11%	11%	17%	12%	8%	4%	12%
Number of Pollutants	23	30	23	23	23	30	23	23
Number of Samples	7	7	7	7	6	5	5	5

NOTE: NA = not available.

QUALITATIVE COMPARISON OF LABORATORIES
PERCENT AGREEMENT AND DISAGREEMENT IN DETECTION/NONDETECTION OF BASE/NEUTRAL EXTRACTABLE TOXIC ORGANIC POLLUTANTS

	Influent Samples				Effluent Samples			
	Lab 1 vs. Lab 2	Lab 2 vs. Lab 3	Lab 1 vs. Lab 3	All Labs	Lab 1 vs. Lab 2	Lab 2 vs. Lab 3	Lab 1 vs. Lab 3	All Labs
Participant A								
Agree	88%	NA	NA	88%	79%	NA	NA	79%
Detected	18%	NA	NA	18%	0%	NA	NA	0%
Nondetected	70%	NA	NA	70%	79%	NA	NA	79%
Disagree	12%	NA	NA	12%	21%	NA	NA	21%
Number of Pollutants	44	NA	NA	44	44	NA	NA	44
Number of Samples	3	NA	NA	3	3	NA	NA	3
Participant D								
Agree	87%	76%	96%	83%	91%	82%	94%	88%
Detected	10%	8%	8%	8%	3%	4%	2%	2%
Nondetected	77%	68%	85%	75%	88%	78%	92%	86%
Disagree	13%	24%	4%	17%	9%	18%	6%	12%
Number of Pollutants	39	43	39	39	39	43	39	39
Number of Samples	7	7	7	7	7	7	7	7
Participant E								
Agree	100%	86%	92%	75%	50%	72%	50%	25%
Detected	100%	86%	92%	75%	50%	36%	42%	25%
Nondetected	0%	0%	0%	0%	0%	36%	8%	0%
Disagree	0%	14%	8%	25%	50%	28%	50%	75%
Number of Pollutants	2	2	2	2	2	2	2	2
Number of Samples	2	7	6	2	2	7	6	2

NOTE: NA = not available.

QUALITATIVE COMPARISON OF LABORATORIES
PERCENT AGREEMENT AND DISAGREEMENT IN DETECTION/NONDETECTION OF ACID EXTRACTABLE TOXIC ORGANIC POLLUTANTS

	Influent Samples				Effluent Samples			
	Lab 1 vs. Lab 2	Lab 2 vs. Lab 3	Lab 1 vs. Lab 3	All Labs	Lab 1 vs. Lab 2	Lab 2 vs. Lab 3	Lab 1 vs. Lab 3	All Labs
Participant A								
Agree	100%	NA	NA	100%	85%	NA	NA	85%
Detected	18%	NA	NA	18%	0%	NA	NA	0%
Nondetected	82%	NA	NA	82%	85%	NA	NA	85%
Disagree	0%	NA	NA	0%	15%	NA	NA	15%
Number of Pollutants	11	NA	NA	11	11	NA	NA	11
Number of Samples	3	NA	NA	3	3	NA	NA	3
Participant B								
Agree	NA	86%	NA	86%	NA	83%	NA	83%
Detected	NA	60%	NA	60%	NA	3%	NA	3%
Nondetected	NA	26%	NA	26%	NA	80%	NA	80%
Disagree	NA	14%	NA	14%	NA	17%	NA	17%
Number of Pollutants	NA	5	NA	5	NA	5	NA	5
Number of Samples	NA	7	NA	7	NA	7	NA	7
Participant D								
Agree	87%	80%	93%	82%	93%	69%	72%	61%
Detected	19%	19%	18%	18%	25%	5%	4%	4%
Nondetected	68%	61%	75%	64%	68%	64%	68%	57%
Disagree	13%	20%	7%	18%	7%	31%	28%	39%
Number of Pollutants	11	11	11	11	11	11	11	11
Number of Samples	7	7	7	7	7	7	7	7
Participant E								
Agree	100%	100%	100%	100%	90%	55%	46%	50%
Detected	100%	100%	100%	100%	50%	46%	43%	50%
Nondetected	0%	0%	0%	0%	40%	9%	3%	0%
Disagree	0%	0%	0%	0%	10%	45%	54%	50%
Number of Pollutants	5	5	5	5	5	5	5	5
Number of Samples	2	7	6	2	2	7	6	2

NOTE: NA = not available.

APPENDIX D

FIVE-PLANT STUDY
TOXIC ORGANIC POLLUTANT DATA

TOXIC ORGANIC POLLUTANTS*
CHEMICAL NAMES AND EPA STORET NUMBERS

BASE/NEUTRAL GROUP

34205	ACENAPHTHENE
34200	ACENAPHTHYLENE
34220	ANTHRACENE [1]
34526	BENZO(A)ANTHRACENE [2]
34230	BENZO(B)FLUORANTHENE [3]
34242	BENZO(K)FLUORANTHENE [3]
34247	BENZO(A)PYRENE
34521	BENZO(G,H)PERYLENE
39120	BENZIDINE
34273	BIS(2-CHLOROETHYL)ETHER
34278	BIS(2-CHLOROETHOXY)METHANE
39100	BIS(2-ETHYLHEXYL)PHTHALATE
34283	BIS(2-CHLOROISOPROPYL)ETHER
34636	4-BROMOPHENYL PHENYL ETHER
34292	BUTYLBENZYLPHTHALATE
34581	2-CHLORONAPHTHALENE
34641	4-CHLOROPHENYL PHENYL ETHER
34320	CHRYSENE [2]
34556	DIBENZO(A,H)ANTHRACENE
39110	DI-N-BUTYLPHTHALATE
34566	1,3-DICHLOROBENZENE [4]
34571	1,4-DICHLOROBENZENE [4]
34536	1,2-DICHLOROBENZENE
34631	3,3′-DICHLOROBENZIDINE
34336	DIETHYLPHTHALATE
34341	DIMETHYLPHTHALATE
34611	2,4-DINITROTOLUENE
34626	2,6-DINITROTOLUENE
34596	DIOCTYLPHTHALATE
34346	1,2-DIPHENYLHYDRAZINE
34376	FLUORANTHENE
34381	FLUORENE
39700	HEXACHLOROBENZENE
34391	HEXACHLOROBUTADIENE
34396	HEXACHLOROETHANE
34386	HEXACHLOROCYCLOPENTADIENE
34403	INDENO(1,2,3-CD)PYRENE
34408	ISOPHORONE
39250	NAPHTHALENE
34447	NITROBENZENE
34438	N-NITROSODIMETHYLAMINE
34428	N-NITROSODI-N-PROPYLAMINE
34433	N-NITROSODIPHENYLAMINE
34461	PHENANTHRENE [1]
34469	PYRENE
34675	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN
34551	1,2,4-TRICHLOROBENZENE

VOLATILE GROUP

34210	ACROLEIN
34215	ACRYLONITRILE
34236	BENZENE
34413	BROMOMETHANE
32101	BROMODICHLOROMETHANE
32104	BROMOFORM
32102	CARBON TETRACHLORIDE
34301	CHLOROBENZENE
34311	CHLOROETHANE
34576	2-CHLOROETHYLVINYL ETHER
32106	CHLOROFORM
34418	CHLOROMETHANE
34105	DIBROMOCHLOROMETHANE
34668	DICHLORODIFLUOROMETHANE
34496	1,1-DICHLOROETHANE
34531	1,2-DICHLOROETHANE
34501	1,1-DICHLOROETHENE
34546	TRANS-1,2-DICHLOROETHENE
34541	1,2-DICHLOROPROPANE
34561	1,3-DICHLOROPROPENE
34371	ETHYLBENZENE
34423	METHYLENE CHLORIDE
34516	1,1,2,2-TETRACHLOROETHANE
34475	TETRACHLOROETHENE
34506	1,1,1-TRICHLOROETHANE
34511	1,1,2-TRICHLOROETHANE
39180	TRICHLOROETHENE
34488	TRICHLOROFLUOROMETHANE
34010	TOLUENE
39175	VINYL CHLORIDE

ACID GROUP

34452	4-CHLORO-3-METHYLPHENOL
34586	2-CHLOROPHENOL
34601	2,4-DICHLOROPHENOL
34606	2,4-DIMETHYLPHENOL
34616	2,4-DINITROPHENOL
34657	2-METHYL-4,6-DINITROPHENOL
34591	2-NITROPHENOL
34646	4-NITROPHENOL
39094	PENTACHLOROPHENOL
34694	PHENOL
34621	2,4,6-TRICHLOROPHENOL

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[1], [2], [3], [4] Listed as isomeric pairs as reported by laboratories.

*Organic toxic pollutant data are listed in tables by EPA STORET number.

KEY TO FIVE-PLANT STUDY DATA TABLES

C* — Concentration from single analysis or one value from replicate analyses.

S — Spike concentration for fortified samples.

R — Percent recovery of spike.

M — Geometric mean of replicate analyses.

SD — Standard deviation ($\log_e$ scale) for replicate analyses.

N — Degrees of freedom (number of analyses minus one) for replicate analyses.

ND — Not detected.

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*C = 1 in replicate analyses is nomenclature for nondetection (zero ppb).

VOLATILE TOXIC ORGANIC

POLLUTANTS

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34215.	17000.	-	-	-	-	-	ND	-	-	-	-	-
34215.	12000.	20000.	45.	-	-	-	ND	-	-	-	-	-
34215.	13000.	-	-	11958.	0.118	1.	ND	-	-	-	-	-
34215.	12000.	10000.	90.	-	-	-	ND	-	-	-	-	-
34215.	31000.	-	-	32465.	0.065	1.	ND	-	-	-	-	-
34215.	13000.	10000.	50.	-	-	-	ND	-	-	-	-	-
34215.	12000.	-	-	11489.	0.062	1.	ND	-	-	-	-	-
34215.	13100.	8460.	86.		-		ND	-	-	-	-	-
34215.	13800.	6190.	111.		-	-	ND	-	-	-	-	-
34215.	11000.	-	-	11050.	0.006	1.	ND	-	-	-	-	-
34215.	9400.	8460.	102.	-	-	-	ND	-	-	-	-	-
34215.	11400.	-	-	11450.	0.006	1.	ND	-	-	-	-	-
34215.	11400.	8400.	102.	-	-	-	ND	-	-	-	-	-
34215.	12500.	-	-	12990.	0.054	1.	ND	-	-	-	-	-
34215.	23000.	-	-	-	-	-	ND	-	-	-	-	-
34215.	320.	-	-	-	-	-	ND	-	-	-	-	-
34215.	20000.	-	-	20494.	0.034	1.	ND	-	-	-	-	-
34215.	600.	-	-	-	-	-	ND	1000.	0.	-	-	-
34215.	14000.	-	-	13491.	0.052	1.	ND	-	-	-	-	-
34215.	4500.	-	-	-	-	-	ND	1000.	85.	-	-	-
34215.	65.	-	-	-	-	-	ND	1000.	250.	-	-	-
34215.	11500.	-	-	10157.	0.176	1.	ND	-	-	-	-	-
34215.	500.	-	-	-	-	-	ND	1000.	270.	-	-	-
34215.	680.	-	-	1428.	1.049	1.	ND	-	-	-	-	-
34215.	40000.	-	-	-	-	-	ND	-	-	-	-	-
34215.	34000.	-	-	24325.	0.474	1.	ND	-	-	-	-	-
34215.	25000.	50000.	190.	-	-	-	ND	-	-	-	-	-
34215.	27000.	50000.	166.	-	-	-	13.	-	-	-	-	-
34215.	27000.	-	-	-	-	-	41.	-	-	42.	0.034	1.
34215.	33000.	-	-	-	-	-	ND	-	-	-	-	-
34215.	210000.	10000.	400.	-	-	-	ND	-	-	-	-	-
34215.	510.	-	-	7489.	3.800	1.	ND	-	-	-	-	-
34215.	890000.	10000.	-7000.	-	-	-	ND	-	-	-	-	-
34215.	174000.	-	-	304000.	0.788	1.	ND	-	-	-	-	-
34215.	290.	-	-	-	-	-	ND	-	-	-	-	-
34215.	178.	-	-	202.	0.181	1.	ND	-	-	-	-	-
34215.	36627.	-	-	-	-	-	810.	-	-	-	-	-
34215.	150000.	-	-	212000.	0.491	1.	ND	-	-	-	-	-
34215.	26000.	-	-	-	-	-	ND	-	-	-	-	-
34215.	26000.	-	-	-	-	-	ND	-	-	-	-	-
34215.	15000.	-	-	15000.	0.000	1.	ND	-	-	-	-	-
34215.	16000.	-	-	-	-	-	ND	-	-	-	-	-
34215.	ND	-	-	-	-	-	1.	-	-	18.	4.056	1.
34215.	28000.	-		20495.	0.441	1.	ND	-	-	-		-
34215.	15000.	-				-	ND	-	-		-	-
34215.	15000.	-	-	15000.	0.000	1.	ND	-	-		-	-
34215.	16000.	50000.	74.	-	-	-	ND	-	-	-	-	-
34215.	960.	-	-	571.	0.736	1.	1.	-	-	2.	1.139	1.
34236.	2700.	3000.	63.	-	-	-	ND	-	-	-	-	-
34236.	2500.	3000.	83.		-	-	5.	-	-	-	-	-
34236.	1900.	-	-	2090.	0.135	1.	ND	-	-	-	-	-
34236.	1000.	1000.	170.	-	-	-	36.	-	-	-	-	-
34236.	1800.	-	-	1587.	0.178	1.	ND	-	-	-	-	-
34236.	1900.	2000.	105.	-	-	-	ND	-	-	-	-	-
34236.	2000.	-	-	1613.	0.306	1.	ND	-	-	-	-	-
34236.	910.	-	-		-	-	ND	-	-	-	-	-
34236.	820.	-	-	-	-	-	ND	-	-	-	-	-
34236.	980.	-	-	-	-	-	ND	-	-	-	-	-
34236.	5.	25.	137.	-	-	-	5.	26.	78.	-	-	-
34236.	11.	25.	96.	-	-	-	5.	25.	77.	-	-	-
34236.	255.	-		245.	0.055	1.	5.	-	-	5.	0.006	1.
34236.	168.	200.		-	-	-	11.	25.	101.	-	-	-
34236.	137.	-		130.	0.010	1.	ND	-	-	-	-	-
34236.	168.	200.	99.	-	-	-	ND	25.	104.	-	-	-
34236.	162.	200.	102.	-	-	-	ND	25.	103.	-	-	-
34236.	208.	-	-	209.	0.010	1.	1.	-	-	2.	1.139	1.
34236.	85.	99.	100.	-	-	-	ND	25.	100.	-	-	-
34236.	184.	-	-	181.	0.023	1.	ND	-	-	-	-	-
34236.	27.	31.	95.	-	-	-	ND	25.	103.	-	-	-
34236.	55.	-	-	58.	0.075	1.	ND	-	-	-	-	-
34236.	59.	25.	83.	-	-	-	ND	25.	113.	-	-	-
34236.	57.	100.	103.	-	-	-	ND	25.	99.	-	-	-
34236.	37.	-	-	37.	0.018	1.	ND	-	-	-	-	-
34236.	168.	200.	112.	-	-	-	ND	25.	100.	-	-	-
34236.	247.	200.	98.	-	-	-	ND	25.	101.	-	-	-
34236.	52.	-	-	52.	0.001	1.	ND	-	-	-	-	-
34236.	61.	-	-	60.	0.026	1.	ND	-	-	-	-	-
34236.	61.	50.	89.	-	-	-	ND	10.	100.	-	-	-
34236.	108.	-	-	106.	0.027	1.	5.	-	-	5.	0.000	1.
34236.	69.	50.	138.		-	-	5.	10.	78.	-	-	-
34236.	43.	100.	99.	-	-	-	ND	25.	89.	-	-	-
34236.	27.	-	-	27.	0.008	1.	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34236.	32.	50.	95.	-	-	-	ND	25.	90.	-	-	-
34236.	38.	50.	100.	-	-	-	ND	25.	99.	-	-	-
34236.	34.	-	-	34.	0.021	1.	ND	-	-	-	-	-
34236.	60.	100.	99.	-	-	-	ND	25.	103.	-	-	-
34236.	40.	50.	92.	-	-	-	5.	100.	79.	-	-	-
34236.	64.	-	-	62.	0.042	1.	5.	-	-	5.	0.000	1.
34236.	1800.	1500.	60.	-	-	-	ND	-	-	-	-	-
34236.	6900.	7000.	73.	-	-	-	5.	2.	0.	-	-	-
34236.	3900.	-	-	-	-	-	ND	-	-	-	-	-
34236.	2200.	4000.	55.	-	-	-	5.	1.	0.	-	-	-
34236.	4600.	-	-	4560.	0.261	2.	5.	-	-	3.	0.929	2.
34236.	7200.	6000.	2.	5560.	0.364	1.	5.	2.	0.	5.	0.000	1.
34236.	2000.	-	-	-	-	-	5.	-	-	-	-	-
34236.	2000.	-	-	-	-	-	5.	-	-	-	-	-
34236.	1380.	-	-	1429.	0.049	1.	ND	-	-	-	-	-
34236.	1910.	-	-	-	-	-	5.	-	-	-	-	-
34236.	5620.	-	-	-	-	-	5.	-	-	-	-	-
34236.	4650.	-	-	-	-	-	ND	-	-	-	-	-
34236.	3360.	-	-	3260.	0.044	2.	ND	-	-	-	-	-
34236.	2670.	-	-	-	-	-	ND	-	-	-	-	-
34236.	9524.	-	-	-	-	-	ND	-	-	-	-	-
34236.	9432.	-	-	9266.	0.025	1.	5.	-	-	5.	0.000	1.
34236.	4620.	-	-	-	-	-	ND	-	-	-	-	-
34236.	8000.	-	-	-	-	-	ND	-	-	-	-	-
34236.	6600.	-	-	-	-	-	ND	-	-	-	-	-
34236.	6200.	-	-	-	-	-	ND	-	-	-	-	-
34236.	6000.	-	-	6210.	0.053	2.	5.	-	-	5.	0.000	2.
34236.	6600.	-	-	-	-	-	ND	-	-	-	-	-
34236.	10800.	-	-	-	-	-	ND	-	-	-	-	-
34236.	13000.	-	-	12900.	0.013	2.	ND	-	-	-	-	-
34236.	9200.	-	-	-	-	-	ND	-	-	-	-	-
34236.	6640.	-	-	-	-	-	ND	-	-	-	-	-
34236.	11000.	-	-	-	-	-	5.	-	-	-	-	-
34236.	12000.	-	-	11700.	0.022	2.	5.	-	-	5.	0.000	2.
34236.	11800.	-	-	-	-	-	5.	-	-	-	-	-
34236.	11200.	-	-	-	-	-	5.	-	-	-	-	-
34236.	2214.	2000.	85.	-	-	-	5.	20.	200.	-	-	-
34236.	2770.	3000.	161.	-	-	-	5.	20.	170.	-	-	-
34236.	1191.	-	-	1120.	0.086	1.	5.	-	-	5.	0.000	1.
34236.	3220.	3000.	-2.	-	-	-	5.	20.	195.	-	-	-
34236.	8350.	-	-	-	-	-	11.	20.	100.	-	-	-
34236.	4090.	-	-	-	-	-	5.	20.	160.	-	-	-
34236.	3360.	-	-	2867.	0.229	1.	5.	-	-	5.	0.000	1.
34236.	2126.	-	-	-	-	-	5.	20.	145.	-	-	-
34236.	4470.	1000.	104.	-	-	-	5.	20.	155.	-	-	-
34236.	1560.	-	-	-	-	-	5.	-	-	5.	0.000	1.
34236.	1220.	1000.	198.	-	-	-	5.	20.	120.	-	-	-
34236.	3150.	1000.	281.	-	-	-	5.	20.	120.	-	-	-
34236.	3160.	4000.	90.	-	-	-	5.	20.	85.	-	-	-
34236.	2271.	4000.	77.	-	-	-	5.	20.	70.	-	-	-
34236.	2778.	-	-	-	-	-	5.	-	-	5.	0.000	1.
34236.	4125.	4000.	62.	-	-	-	5.	20.	125.	-	-	-
34236.	2900.	1000.	-26.	-	-	-	5.	20.	30.	-	-	-
34236.	3450.	-	-	-	-	-	5.	-	-	5.	0.000	1.
34236.	1880.	1000.	237.	-	-	-	5.	20.	0.	-	-	-
34236.	1520.	1000.	217.	-	-	-	5.	20.	35.	-	-	-
34236.	5515.	1000.	549.	-	-	-	24.	20.	10.	-	-	-
34236.	8187.	-	-	-	-	-	5.	20.	65.	-	-	-
34236.	6016.	1000.	558.	-	-	-	5.	20.	55.	-	-	-
34236.	3816.	-	-	-	-	-	5.	20.	40.	-	-	-
34236.	210.	200.	105.	-	-	-	5.	2.	0.	-	-	-
34236.	210.	210.	100.	-	-	-	ND	-	-	-	-	-
34236.	29.	-	-	33.	0.191	1.	5.	-	-	5.	0.000	1.
34236.	98.	100.	212.	-	-	-	5.	2.	0.	-	-	-
34236.	120.	-	-	125.	0.057	1.	ND	-	-	-	-	-
34236.	140.	150.	87.	-	-	-	5.	3.	0.	-	-	-
34236.	1300.	-	-	1020.	0.343	1.	5.	-	-	5.	0.000	1.
34236.	51.	85.	71.	-	-	-	ND	-	-	-	-	-
34236.	178.	156.	34.	-	-	-	ND	-	-	-	-	-
34236.	14.	-	-	13.	0.109	1.	ND	-	-	-	-	-
34236.	453.	855.	176.	-	-	-	ND	-	-	-	-	-
34236.	59.	-	-	61.	0.046	1.	ND	-	-	-	-	-
34236.	38.	88.	111.	-	-	-	5.	-	-	2.	1.138	1.
34236.	615.	-	-	611.	0.009	1.	ND	-	-	-	-	-
34236.	143.	-	-	-	-	-	ND	-	-	-	-	-
34236.	170.	-	-	-	-	-	ND	-	-	-	-	-
34236.	89.	-	-	191.	1.080	1.	ND	100.	96.	-	-	-
34236.	188.	100.	26.	-	-	-	ND	-	-	-	-	-
34236.	83.	-	-	73.	0.173	1.	ND	-	-	-	-	-
34236.	640.	1000.	144.	-	-	-	ND	20.	70.	-	-	-
34236.	130.	1000.	83.	-	-	-	ND	20.	78.	-	-	-
34236.	520.	-	-	653.	0.322	1.	35.	-	-	31.	0.158	1.

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34236.	110.	1000.	99.	-	-	-	5.	20.	115.	-	-	-
34236.	140.	-	-	326.	1.195	1.	ND	20.	67.	-	-	-
34236.	1400.	1000.	37.	-	-	-	ND	100.	130.	-	-	-
34236.	180.	-	-	710.	1.940	1.	ND	-	-		-	-
34236.	220.	1000.	101.	-	-	-	ND	100.	100.	-	-	-
34236.	1200.	1000.	61.	-	-	-	ND	100.	100.	-	-	-
34236.	87.	-	-	135.	0.623	1.	33.	-	-	77.	1.199	1.
34236.	66.	5000.	99.	-	-	-	200.	100.	-202.	-	-	-
34236.	150.	1000.	110.	-	-	-	ND	100.	96.	-	-	-
34236.	390.	1000.	71.	-	-	-	ND	100.	110.			-
34236.	230.	-	-	230.	0.000	1.	ND	-	-		-	-
34236.	110.	1000.	83.	-	-	-	ND	20.	110.	-	-	-
34236.	750.	1000.	95.	-	-	-	ND	200.	110.	-	-	-
34236.	ND	5000.	186.	-	-	-	ND	100.	58.	-	-	-
34236.	ND	5000.	220.	-	-	-	ND	100.	85.	-	-	-
34236.	ND	1000.	95.	-	-	-	ND	100.	106.	-	-	-
34236.	ND	1000.	106.	-	-	-	ND	100.	150.	-	-	-
34236.	ND	1000.	71.	-	-	-	ND	-	-	-	-	-
34236.	ND	10000.	110.	-	-	-	ND	100.	101.	-	-	-
34413.	1200.	-	-	-	-	-	ND	-	-	-	-	-
34413.	1000.	-	-	-	-	-	ND	1000.	1120.	-	-	-
34413.	1000.	-	-	1600.	0.000	1.	ND	-	-	-	-	-
34413.	820.	-	-	1984.	1.249	1.	ND	-	-	-	-	-
34413.	190.	-	-	131.	0.528	1.	ND	-	-	-	-	-
34413.	210.	-	-	476.	1.157	1.	ND	-	-	-	-	-
34413.	5000.	-	-	-	-	-	ND	-	-	-	-	-
34413.	2500.	-	-	2449.	0.029	1.	ND	-	-	-	-	-
34413.	ND	-	-	-	-	-	ND	1000.	1120.	-	-	-
34413.	ND	5000.	20.	-	-	-	ND	500.	28.	-	-	-
34413.	ND	5000.	19.	-	-	-	ND	500.	51.	-	-	-
34413.	ND	5000.	16.	-	-	-	ND	500.	27.	-	-	-
34413.	ND	-	-	-	-	-	ND	500.	84.	-	-	-
34413.	ND	-	-	-	-	-	ND	500.	66.	-	-	-
34413.	ND	-	-	-	-	-	ND	100.	430.	-	-	-
34413.	15000.	-	-	13964.	0.101	1.	ND	-	-	-	-	-
34413.	ND	5000.	20.	-	-	-	ND	500.	46.	-	-	-
34413.	ND	5000.	6000.	-	-	-	ND	-	-	-	-	-
34413.	ND	5000.	0.	-	-	-	ND	500.	32.	-	-	-
34413.	ND	5000.	82.	-	-	-	ND	500.	8.	-	-	-
34413.	ND	5000.	110.	-	-	-	ND	100.	110.	-	-	-
34413.	ND	5000.	80.	-	-	-	ND	1000.	99.	-	-	-
34413.	ND	50000.	80.	-	-	-	ND	500.	66.	-	-	-
32101.	26.	-	-	40.	0.603	1.	1.	-	-	2.	1.139	1.
32101.	26.	25.	216.	-	-	-	ND	-	-	-	-	-
32101.	5.	-	-	-	-	-	ND	-	-	-	-	-
32101.	96.	-	-	-	-	-	ND	-	-	-	-	-
32101.	40.	-	-	44.	0.064	1.	ND	-	-	-	-	-
32101.	110.	-	-	-	-	-	ND	-	-	-	-	-
32101.	55.	-	-	-	-	-	ND	-	-	-	-	-
32101.	12.	-	-	-	-	-	ND	-	-	-	-	-
32101.	48.	-	-	-	-	-	ND	-	-	-	-	-
32101.	18.	-	-	21.	0.168	2.	ND	-	-	-	-	-
32101.	24.	-	-	-	-	-	ND	-	-	-	-	-
32101.	31.	-	-	-	-	-	ND	-	-	-	-	-
32101.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
32101.	5.	-	-	-	-	-	ND	-	-	-	-	-
32101.	ND	-	-	-	-	-	5.	20.	115.	-	-	-
32101.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
32101.	5.	-	-	-	-	-	ND	20.	165.	-	-	-
32101.	5.	20.	0.	-	-	-	ND	-	-	-	-	-
32101.	72.	100.	71.	-	-	-	5.	25.	540.	-	-	-
32101.	52.	-	-	31.	0.750	1.	5.	-	-	5.	0.000	1.
32101.	135.	100.	83.	-	-	-	5.	25.	484.	-	-	-
32101.	94.	100.	150.	-	-	-	5.	25.	560.	-	-	-
32101.	5.	25.	36.	-	-	-	5.	25.	72.	-	-	-
32101.	11.	-	-	3.	1.696	1.	5.	-	-	2.	1.138	1.
32101.	6.	25.	88.	-	-	-	ND	25.	116.	-	-	-
32101.	34.	20.	85.	-	-	-	ND	-	-	-	-	-
32101.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
32101.	5.	20.	105.	-	-	-	ND	-	-	-	-	-
32101.	10.	20.	60.	-	-	-	ND	-	-	-	-	-
32101.	ND	20.	15.	-	-	-	5.	25.	48.	-	-	-
32101.	6.	20.	225.	-	-	-	ND	25.	60.	-	-	-
32101.	ND	-	-	-	-	-	ND	20.	155.	-	-	-
32101.	ND	20.	15.	-	-	-	ND	-	-	-	-	-
32101.	ND	20.	15.	-	-	-	ND	-	-	-	-	-
32101.	ND	25.	196.	-	-	-	ND	25.	132.	-	-	-
32101.	ND	20.	325.	-	-	-	ND	25.	56.	-	-	-
32101.	ND	20.	250.	-	-		ND	25.	48.	-	-	-
32101.	260.	300.	87.	-	-	-	ND	-	-	-	-	-
32104.	ND	10000.	120.	-	-	-	ND	-	-	-	-	-
32102.	ND	-	-	-	-	-	ND	24.	94.	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
32102.	ND	-	-	-	-	-	ND	26.	97.	-		-
32102.	209.	-	-	209.	0.034	1.	ND	-	-	-	-	-
32102.	131.	-	-	123.	0.086	1.	ND	-	-	-	-	-
32102.	5.	50.	248.	-	-	-	ND	-	-	-	-	-
32102.	ND	50.	72.	-	-	-	ND	-	-	-	-	-
32102.	ND	50.	80.	-	-	-	ND	-	-	-	-	-
32102.	ND	1000.	110.	-	-	-	ND	-	-	-	-	-
32102.	ND	10000.	120.	-	-	-	ND	-	-	-	-	-
34301.	5.	-	-	-	-	-	ND	-	-	-	-	-
34301.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34301.	5.	-	-	-	-	-	ND	-	-	-	-	-
34301.	5.	-	-	-	-	-	ND	-	-	-	-	-
34301.	5.	-	-	-	-	-	ND	-	-	-	-	-
34301.	5.	-	-	-	-	-	ND	-	-	-	-	-
34301.	5.	-	-	3.	0.929	2.	ND	-	-	-	-	-
34301.	5.	20.	305.	-	-	-	ND	-	-	-	-	-
34301.	ND	20.	330.	-	-	-	ND	-	-	-	-	-
34301.	ND	20.	340.	-	-	-	ND	-	-	-	-	-
34301.	ND	20.	300.	-	-	-	ND	-	-	-	-	-
34301.	30.	30.	73.	-	-	-	ND	-	-	-	-	-
34301.	25.	25.	92.	-	-	-	ND	-	-	-	-	-
34301.	33.	30.	110.	-	-	-	ND	-	-	-	-	-
34301.	26.	-	-	19.	0.438	1.	ND	-	-	-	-	-
34301.	36.	117.	83.	-	-	-	ND	-	-	-	-	-
34301.	14.	-	-	-	-	-	ND	-	-	-	-	-
34301.	137.	-	-	-	-	-	ND	-	-	-	-	-
34301.	34.	100.	184.	-	-	-	ND	100.	102.	-	-	-
34301.	120.	-	-	130.	0.109	1.	ND	-	-	-	-	-
34301.	37.	1000.	96.	-	-	-	ND	20.	81.	-	-	-
34301.	49.	1000.	88.	-	-	-	ND	20.	89.	-	-	-
34301.	160.	-	-	112.	0.508	1.	ND	-	-	-	-	-
34301.	18.	1000.	90.	-	-	-	ND	20.	87.	-	-	-
34301.	25.	-	-	17.	0.580	1.	ND	20.	85.	-	-	-
34301.	26.	1000.	90.	-	-	-	ND	100.	99.	-	-	-
34301.	32.	-	-	27.	0.233	1.	ND	-	-	-	-	-
34301.	18.	1000.	130.	-	-	-	ND	100.	180.	-	-	-
34301.	28.	1000.	87.	-	-	-	ND	100.	110.	-	-	-
34301.	18.	-	-	19.	0.209	1.	ND	-	-	-	-	-
34301.	ND	5000.	46.	-	-	-	16.	100.	161.	-	-	-
34301.	12.	-	-	23.	0.919	1.	ND	-	-	-	-	-
34301.	ND	5000.	101.	-	-	-	ND	100.	102.	-	-	-
34301.	ND	5000.	120.	-	-	-	ND	100.	120.	-	-	-
34301.	ND	1000.	100.	-	-	-	ND	100.	120.	-	-	-
34301.	ND	1000.	120.	-	-	-	ND	100.	106.	-	-	-
34301.	ND	1000.	110.	-	-		ND	100.	90.	-	-	-
34301.	120.	-	-	139.	0.203	1.	ND	-	-	-	-	-
34301.	ND	1000.	99.	-	-	-	ND	100.	84.	-	-	-
34301.	ND	1000.	86.	-	-	-	ND	-	-	-	-	-
34301.	ND	1000.	120.	-	-	-	ND	20.	105.	-	-	-
34301.	ND	1000.	110.	-	-	-	ND	200.	100.	-	-	-
34301.	ND	10000.	110.	-	-	-	ND	100.	96.	-	-	-
34311.	1556.	-	-	1559.	0.003	1.	5.	-	-	5.	0.000	1.
34311.	ND	-	-	-	-	-	5.	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34311.	72.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	17.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	3.	0.929	2.	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	5.	-	-	-	-	-	ND	-	-	-	-	-
34311.	763.	-	-	767.	0.007	1.	ND	-	-	-	-	-
34311.	24.	96.	136.	-	-	-	ND	-	-	-	-	-
34311.	ND	482.	131.	-	-	-	ND	-	-	-	-	-
34311.	ND	482.	169.	-	-	-	ND	-	-	-	-	-
34311.	ND	482.	570.	-	-	-	ND	-	-	-	-	-
34311.	ND	96.	103.	-	-	-	ND	-	-	-	-	-
34311.	ND	96.	149.	-	-	-	ND	-	-	-	-	-
32106.	30.	30.	77.	-	-	-	46.	40.	108.	-	-	-
32106.	13.	10.	50.	-	-	-	37.	40.	183.	-	-	-
32106.	36.	-	-	35.	0.040	1.	120.	-	-	110.	0.129	1.
32106.	10.	10.	100.	-	-	-	42.	40.	118.	-	-	-
32106.	ND	-	-	-	-	-	45.	-	-	42.	0.101	1.
32106.	ND	-	-	-	-	-	25.	-	-	24.	0.059	1.

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
32106.	ND	-	-	-	-	-	27.	-	-	33.	0.278	1.
32106.	12.	-	-	-	-	-	16.	-	-	-	-	-
32106.	ND	-	-	-	-	-	18.	-	-	-	-	-
32106.	27.	-	-	-	-	-	16.	-	-	-	-	-
32106.	44.	40.	55.	-	-	-	5.	2.	0.	-	-	-
32106.	2600.	3000.	83.	-	-	-	17.	15.	53.	-	-	-
32106.	3000.	-	-	3420.	0.185	1.	30.	-	-	35.	0.221	1.
32106.	2000.	2000.	90.		-	-	14.	10.	60.	-	-	-
32106.	630.			540.	0.239	2.	5.			5.	0.000	2.
32106.	91.	90.	232.	100.	0.134	1.	5.	3.	0.	5.	0.000	1.
32106.	46.	-	-	-	-	-	ND	-	-	-	-	-
32106.	1840.	-	-	1784.	0.044	1.	25.	-	-	25.	0.000	1.
32106.	982.	-	-	-	-	-	18.	-	-	-	-	-
32106.	604.	-	-	-	-	-	ND	-	-	-	-	-
32106.	3770.	-	-	-	-	-	11.	-	-	-	-	-
32106.	625.	-	-	627.	0.029	2.	15.	-	-	15.	0.000	1.
32106.	56.	-	-	-	-	-	5.	-	-	-	-	-
32106.	4238.	-	-	-	-	-	5.	-	-	-	-	-
32106.	5360.	-	-	5151.	0.056	1.	30.	-	-	30.	0.023	1.
32106.	6600.	-	-	-	-	-	31.	-	-	-	-	-
32106.	5200.	-	-	-	-	-	45.	-	-	-	-	-
32106.	1660.	-	-	-	-	-	10.	-	-	-	-	-
32106.	3130.	-	-	-	-	-	11.	-	-	-	-	-
32106.	1575.	-	-	1600.	0.109	2.	13.	-	-	13.	0.155	2.
32106.	2040.	-	-	-	-	-	13.	-	-	-	-	-
32106.	1550.	-	-	-	-	-	5.	-	-	-	-	-
32106.	800.	-	-	806.	0.062	2.	5.	-	-	5.	0.000	2.
32106.	300.	-	-	-	-	-	5.	-	-	-	-	-
32106.	480.	-	-	-	-	-	10.	-	-	-	-	-
32106.	260.	-	-	-	-	-	11.	-	-	-	-	-
32106.	105.	-	-	106.	0.030	2.	5.	-	-	5.	0.000	2.
32106.	100.	-	-	-	-	-	5.	-	-	-	-	-
32106.	118.	-	-	-	-	-	5.	-	-	-	-	-
32106.	81.	100.	55.	-	-	-	5.	20.	175.	-	-	-
32106.	57.	100.	80.	-	-	-	5.	20.	160.	-	-	-
32106.	1821.	-	-	1748.	0.058	1.	12.	-	-	12.	0.057	1.
32106.	824.	1100.	117.	-	-	-	26.	20.	155.	-	-	-
32106.	ND	-	-	-	-	-	27.	20.	240.	-	-	-
32106.	3310.	3150.	222.	-	-	-	18.	20.	195.	-	-	-
32106.	1560.	-	-	1703.	0.124	1.	25.	-	-	28.	0.152	1.
32106.	154.	150.	399.	-	-	-	5.	20.	205.	-	-	-
32106.	4150.	2000.	-10.	-	-	-	23.	20.	145.	-	-	-
32106.	3740.	-	-	4029.	0.105	1.	57.	-	-	61.	0.104	1.
32106.	4990.	2000.	129.	-	-	-	65.	70.	134.	-	-	-
32106.	4170.	2000.	254.	-	-	-	91.	90.	171.	-	-	-
32106.	1919.	2000.	90.	-	-	-	17.	20.	145.	-	-	-
32106.	2161.	2000.	74.	-	-	-	16.	20.	90.	-	-	-
32106.	2629.	-	-	2530.	0.054	1.	19.	-	-	19.	0.000	1.
32106.	2327.	2000.	72.	-	-	-	17.	20.	120.	-	-	-
32106.	1600.	400.	33.	-	-	-	5.	20.	50.	-	-	-
32106.	587.	-	-	679.	0.206	1.	5.	-	-	5.	0.000	1.
32106.	426.	400.	82.	-	-	-	5.	20.	0.	-	-	-
32106.	603.	400.	129.	-	-	-	5.	20.	65.	-	-	-
32106.	140.	100.	552.	-	-	-	17.	20.	80.	-	-	-
32106.	175.	100.	436.	-	-	-	5.	20.	55.	-	-	-
32106.	186.	100.	247.	-	-	-	5.	20.	40.	-	-	-
32106.	211.	100.	380.	-	-	-	5.	20.	30.	-	-	-
32106.	13.	13.	177.	-	-	-	ND	-	-	-	-	-
32106.	14.	159.	65.	-	-	-	ND	-	-	-	-	-
32106.	5.	-	-	-	-	-	ND	-	-	-	-	-
32106.	5.	-	-	-	-	-	ND	-	-	-	-	-
32106.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
32106.	ND	-	-	-	-	-	5.	100.	128.	-	-	-
32106.	ND	100.	86.	-	-	-	ND	-	-	-	-	-
32106.	ND	-	-	-	-	-	ND	20.	67.	-	-	-
32106.	ND	-	-	-	-	-	ND	20.	74.	-	-	-
32106.	ND	1000.	553.	-	-	-	ND	20.	74.	-	-	-
32106.	ND	-	-	-	-	-	ND	20.	69.	-	-	-
32106.	ND	1000.	100.	-	-	-	ND	200.	100.	-	-	-
32106.	ND	10000.	110.	-	-	-	ND	100.	96.	-	-	-
34105.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34105.	5.	-	-	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34105.	5.	-	-	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34105.	5.	-	-	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	-	-	-	ND	-	-	-	-	-
34105.	5.	20.	115.	-	-	-	ND	-	-	-	-	-
34105.	5.	20.	-25.	-	-	-	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34105.	21.	20.	25.	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34105.	19.	20.	65.	-	-	-	ND	-	-	-	-	-
34105.	18.	20.	80.	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34105.	5.	20.	105.	-	-	-	ND	-	-	-	-	-
34105.	5.	20.	120.	-	-	-	ND	-	-	-	-	-
34105.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34105.	5.	20.	145.	-	-	-	ND	-	-	-	-	-
34105.	ND	20.	95.	-		-	ND	-	-	-	-	-
34105.	ND	20.	75.	-	-	-	ND	-	-	-	-	-
34105.	ND	20.	145.	-	-	-	ND	-	-	-	-	-
34105.	ND	20.	140.	-	-	-	ND	-	-	-	-	-
34105.	5.	20.	145.	-	-	-	ND	-	-	-	-	-
34496.	ND	-	-	-	-	-	ND	20.	95.	-	-	-
34496.	ND	-	-	-	-	-	ND	24.	95.	-	-	-
34496.	367.	-	-	374.	0.828	1.	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	11.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	1.	-	-	2.	0.929	2.	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	-	-	-	ND	-	-	-	-	-
34496.	867.	-	-	797.	0.120	1.	5.	-	-	5.	0.000	1.
34496.	12.	100.	711.	-	-	-	ND	20.	240.	-	-	-
34496.	13.	20.	100.	-	-	-	ND	-	-	-	-	-
34496.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34496.	20.	20.	-75.	-	-	-	ND	-	-	-	-	-
34496.	5.	20.	75.	-	-	-	ND	-	-	-	-	-
34496.	ND	100.	149.	-	-	-	ND	20.	215.	-	-	-
34496.	ND	100.	171.	-	-	-	ND	20.	190.	-	-	-
34531.	290.	300.	87.	-	-	-	11.	10.	50.	-	-	-
34531.	270.	300.	277.	-	-	-	26.	10.	-80.	-	-	-
34531.	200.	-	-	283.	0.490	1.	5.	-	-	5.	0.000	1.
34531.	530.	500.	24.	-	-	-	10.	10.	30.	-	-	-
34531.	200.	-	-	292.	0.383	2.	5.	-	-	5.	0.000	2.
34531.	320.	320.	213.	339.	0.083	1.	5.	8.	275.	7.	0.490	1.
34531.	418.	-	-	-	-	-	5.	-	-	-	-	-
34531.	224.	-	-	-	-	-	16.	-	-	-	-	-
34531.	7560.	-	-	7757.	0.036	1.	218.	-	-	210.	0.060	2.
34531.	408.	-	-	-	-	-	185.	-	-	-	-	-
34531.	405.	-	-	-	-	-	5.	-	-	-	-	-
34531.	264.	-	-	-	-	-	12.	-	-	-	-	-
34531.	246.	-	-	250.	0.029	2.	5.	-	-	5.	0.000	1.
34531.	319.	-	-	-	-	-	5.	-	-	-	-	-
34531.	1090.	-	-	-	-	-	5.	-	-	-	-	-
34531.	675.	-	-	692.	0.036	1.	5.	-	-	5.	0.000	1.
34531.	670.	-	-	-	-	-	5.	-	-	-	-	-
34531.	662.	-	-	-	-	-	5.	-	-	-	-	-
34531.	1470.	-	-	-	-	-	5.	-	-	-	-	-
34531.	2060.	-	-	-	-	-	5.	-	-	-	-	-
34531.	900.	-	-	952.	0.064	2.	5.	-	-	7.	0.455	2.
34531.	810.	-	-	-	-	-	5.	-	-	-	-	-
34531.	1020.	-	-	-	-	-	5.	-	-	-	-	-
34531.	890.	-	-	799.	0.122	2.	5.	-	-	5.	0.000	2.
34531.	50000.	-	-	-	-	-	17.	-	-	-	-	-
34531.	1230.	-	-	-	-	-	124.	-	-	-	-	-
34531.	600.	-	-	-	-	-	5.	-	-	-	-	-
34531.	820.	-	-	788.	0.055	2.	5.	-	-	5.	0.000	2.
34531.	630.	-	-	-	-	-	5.	-	-	-	-	-
34531.	480.	-	-	-	-	-	5.	-	-	-	-	-
34531.	616.	500.	167.	-	-	-	5.	20.	135.	-	-	-
34531.	348.	500.	144.	-	-	-	11.	20.	180.	-	-	-
34531.	24100.	-	-	21734.	0.146	1.	116.	-	-	117.	0.006	1.
34531.	623.	500.	619.	-	-	-	175.	20.	-15.	-	-	-
34531.	654.	-	-	-	-	-	5.	20.	110.	-	-	-
34531.	312.	400.	270.	-	-	-	12.	20.	145.	-	-	-
34531.	251.	-	-	278.	0.145	1.	5.	-	-	5.	0.000	1.
34531.	309.	400.	395.	-	-	-	5.	20.	180.	-	-	-
34531.	415.	100.	-36.	-	-	-	5.	20.	190.	-	-	-
34531.	253.	-	-	301.	0.247	1.	5.	-	-	5.	0.000	1.
34531.	213.	100.	328.	-	-	-	5.	20.	190.	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34531.	87.	100.	666.	-	-	-	5.	20.	190.	-	-	-
34531.	424.	150.	162.	-	-	-	5.	20.	120.	-	-	-
34531.	380.	150.	144.	-	-	-	5.	20.	85.	-	-	-
34531.	278.	-	-	279.	0.008	1.	5.	-	-	5.	0.000	1.
34531.	221.	150.	105.	-	-	-	5.	20.	115.	-	-	-
34531.	337.	300.	118.	-	-	-	5.	20.	45.	-	-	-
34531.	302.	-	-	278.	0.117	1.	5.	-	-	5.	0.000	1.
34531.	9490.	300.	570.	-	-	-	14.	20.	25.	-	-	-
34531.	377.	300.	101.	-	-	-	58.	20.	180.	-	-	-
34531.	123.	100.	194.	-	-	-	5.	20.	100.	-	-	-
34531.	246.	100.	279.	-	-	-	5.	20.	70.	-	-	-
34531.	174.	100.	199.	-	-	-	5.	20.	65.	-	-	-
34531.	146.	100.	295.	-	-	-	5.	20.	50.	-	-	-
34531.	1500.	2000.	95.	-	-	-	ND	-	-	-	-	-
34531.	530.	500.	134.	-	-	-	ND	-	-	-	-	-
34531.	550.	3000.	145.	-	-	-	ND	-	-	-	-	-
34531.	910.	-	-	843.	0.109	1.	20.	-	-	15.	0.361	1.
34531.	1060.	892.	173.	-	-	-	ND	-	-	-	-	-
34531.	648.	508.	75.	-	-	-	1.	-	-	2.	1.139	1.
34531.	216.	-	-	220.	0.026	1.	ND	-	-	-	-	-
34531.	10.	-	-	-	-	-	ND	-	-	-	-	-
34531.	170.	-	-	165.	0.038	1.	13.	-	-	13.	0.000	1.
34531.	ND		-	-	-	-	5.	-	-	5.	0.000	1.
34531.	2450.	1000.	145.	-	-	-	ND	20.	95.	-	-	-
34531.	450.	-	-	400.	0.138	1.	25.	-	-	25.	0.078	1.
34531.	3900.	1000.	100.	-	-	-	50.	20.	95.	-	-	-
34531.	530.	-	-	569.	0.099	1.	11.	20.	115.	-	-	-
34531.	35.	1000.	42.	-	-	-	ND	-	-	-	-	-
34531.	550.	-	-	625.	0.181	1.	ND	-	-	-	-	-
34531.	790.	1000.	101.	-	-	-	5.	200.	113.	-	-	-
34531.	370.	-	-	380.	0.037	1.	5.	-	-	5.	0.000	1.
34531.	3500.	10000.	75.	-	-	-	11.	100.	99.	-	-	-
34531.	347.	-	-	261.	0.400	1.	15.	-	-	15.	0.000	1.
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	11.	-	-	-	-	-	ND	-	-	-	-	-
34501.	48.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	-	-	-	ND	-	-	-	-	-
34501.	8.	-	-	2.	0.929	2.	ND	-	-	-	-	-
34501.	42.	40.	10.	-	-	-	ND	-	-	-	-	-
34501.	5.	40.	90.	-	-	-	ND	-	-	-	-	-
34501.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34501.	5.	40.	243.	-	-	-	ND	-	-	-	-	-
34501.	89.	-	-	-	-	-	ND	-	-	-	-	-
34501.	124.	-	-	117.	0.085	1.	ND	-	-	-	-	-
34501.	24.	-	-	-	-	-	ND	-	-	-	-	-
34501.	5.	20.	135.	-	-	-	ND	-	-	-	-	-
34501.	13.	-	-	14.	0.101	1.	ND	-	-	-	-	-
34501.	5.	20.	60.	-	-	-	ND	-	-	-	-	-
34501.	5.	20.	375.	-	-	-	ND	20.	40.	-	-	-
34501.	ND	40.	105.	-	-	-	ND	-	-	-	-	-
34501.	ND	-	-	-	-	-	ND	10.	110.	-	-	-
34501.	ND	20.	225.	-	-	-	ND	-	-	-	-	-
34501.	ND	20.	395.	-	-	-	ND	-	-	-	-	-
34501.	ND	20.	340.	-	-	-	ND	-	-	-	-	-
34501.	ND	1000.	113.	-	-	-	ND	20.	60.	-	-	-
34501.	ND	5000.	300.	-	-	-	ND	100.	113.	-	-	-
34501.	ND	5000.	300.	-	-	-	ND	100.	71.	-	-	-
34501.	ND	1000.	0.	-	-	-	ND	100.	0.	-	-	-
34501.	ND	1000.	0.	-	-	-	ND	100.	42.	-	-	-
34501.	ND	1000.	85.	-	-	-	ND	100.	18.	-	-	-
34501.	ND	1000.	40.	-	-	-	ND	-	-	-	-	-
34501.	ND	1000.	75.	-	-	-	ND	200.	125.	-	-	-
34501.	ND	10000.	78.	-	-	-	ND	100.	121.	-	-	-
34501.	780.	-	-	867.	0.187	1.	ND	-	-	-	-	-
34501.	2000.	11000.	118.	-	-	-	ND	-	-	-	-	-
34501.	1200.	-	-	1386.	0.203	1.	ND	-	-	-	-	-
34501.	318.	1020.	101.	-	-	-	ND	-	-	-	-	-
34501.	392.	374.	124.	-	-	-	ND	-	-	-	-	-
34501.	480.	-	-	443.	0.115	1.	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34501.	269.	1020.	118.	-	-	-	ND	-	-	-	-	-
34501.	209.	-	-	192.	0.118	1.	ND	-	-	-	-	-
34501.	162.	203.	241.	-	-	-	ND	-	-	-	-	-
34501.	148.	-	-	149.	0.009	1.	ND	-	-	-	-	-
34501.	280.	-	-	-	-	-	ND	-	-	-	-	-
34501.	386.	-	-	-	-	-	ND	-	-	-	-	-
34501.	360.	-	-	19.	4.162	1.	ND	-	-	-	-	-
34501.	590.	100.	60.	-	-	-	ND	100.	78.	-	-	-
34501.	535.	-	-	501.	0.092	1.	ND	-	-	-	-	-
34501.	410.	1000.	201.	-	-	-	ND	20.	65.	-	-	-
34501.	250.	-	-	-	-	-	ND	20.	58.	-	-	-
34501.	286.	-	-	256.	0.154	1.	ND	-	-	-	-	-
34501.	1.	-	-	15.	3.814	1.	ND	20.	132.	-	-	-
34501.	68.	1000.	20.	-	-	-	ND	100.	59.	-	-	-
34501.	35.	1000.	27.	-	-	-	ND	100.	280.	-	-	-
34501.	43.	1000.	30.	-	-	-	ND	100.	110.	-	-	-
34501.	1.	-	-	7.	2.737	1.	ND	-	-	-	-	-
34501.	730.	5000.	205.	-	-	-	ND	100.	240.	-	-	-
34501.	1.	-	-	14.	3.746	1.	ND	-	-	-	-	-
34501.	270.	1000.	61.	-	-	-	ND	100.	88.	-	-	-
34501.	1.	-	-	25.	4.558	1.	ND	-	-	-	-	-
34501.	1.	-	-	18.	4.079	1.	ND	-	-	-	-	-
34501.	600.	1000.	100.	-	-	-	ND	20.	100.	-	-	-
34546.	27.	-	-	12.	1.193	1.	ND	-	-	-	-	-
34546.	760.	-	-	750.	0.019	1.	5.	-	-	5.	0.000	2.
34546.	ND	-	-	-	-	-	5.	-	-	-	-	-
34546.	236.	-	-	277.	0.226	1.	5.	-	-	5.	0.000	1.
34546.	17.	100.	500.	-	-	-	ND	20.	270.	-	-	-
34546.	ND	100.	149.	-	-	-	ND	20.	265.	-	-	-
34546.	ND	100.	190.	-	-	-	ND	20.	220.	-	-	-
34546.	5.	100.	135.	-	-	-	ND	-	-	-	-	-
34546.	5.	-	-	7.	0.491	1.	ND	-	-	-	-	-
34546.	ND	-	-	-	-	-	ND	20.	75.	-	-	-
34546.	ND	-	-	-	-	-	ND	20.	75.	-	-	-
34546.	ND	-	-	-	-	-	ND	20.	66.	-	-	-
34546.	ND	1000.	110.	-	-	-	ND	200.	115.	-	-	-
34546.	ND	10000.	99.	-	-	-	ND	100.	106.	-	-	-
34546.	110.	1000.	89.	-	-	-	ND	20.	67.	-	-	-
34541.	38.	40.	255.	-	-	-	ND	-	-	-	-	-
34541.	63.	60.	62.	-	-	-	5.	2.	0.	-	-	-
34541.	160.	-	-	139.	0.203	1.	5.	-	-	5.	0.000	1.
34541.	130.	130.	38.	-	-	-	5.	1.	0.	-	-	-
34541.	82.	-	-	76.	0.581	2.	5.	-	-	5.	0.000	2.
34541.	1100.	2000.	105.	967.	0.182	1.	33.	30.	160.	30.	0.116	1.
34541.	285.	-	-	-	-	-	ND	-	-	-	-	-
34541.	210.	-	-	-	-	-	ND	-	-	-	-	-
34541.	150.	-	-	154.	0.037	1.	5.	-	-	5.	0.000	2.
34541.	224.	-	-	-	-	-	5.	-	-	-	-	-
34541.	83.	-	-	-	-	-	ND	-	-	-	-	-
34541.	111.	-	-	-	-	-	ND	-	-	-	-	-
34541.	58.	-	-	59.	0.044	2.	ND	-	-	-	-	-
34541.	88.	-	-	-	-	-	ND	-	-	-	-	-
34541.	237.	-	-	-	-	-	5.	-	-	-	-	-
34541.	93.	-	-	90.	0.047	1.	5.	-	-	5.	0.000	1.
34541.	69.	-	-	-	-	-	ND	-	-	-	-	-
34541.	118.	-	-	-	-	-	ND	-	-	-	-	-
34541.	51.	-	-	-	-	-	ND	-	-	-	-	-
34541.	200.	-	-	-	-	-	ND	-	-	-	-	-
34541.	40.	-	-	43.	0.231	2.	ND	-	-	-	-	-
34541.	36.	-	-	-	-	-	ND	-	-	-	-	-
34541.	204.	-	-	-	-	-	ND	-	-	-	-	-
34541.	86.	-	-	69.	0.195	2.	ND	-	-	-	-	-
34541.	46.	-	-	-	-	-	ND	-	-	-	-	-
34541.	213.	-					ND	-	-			-
34541.	14000.	-	-	-	-	-	38.	-	-	-	-	-
34541.	1470.	-	-	1460.	0.036	2.	15.	-	-	15.	0.040	2.
34541.	560.	-	-	-	-	-	5.	-	-	-	-	-
34541.	305.	-	-	-	-	-	5.	-	-	-	-	-
34541.	233.	200.	183.	-	-	-	5.	20.	240.	-	-	-
34541.	217.	200.	85.	-	-	-	5.	20.	170.	-	-	-
34541.	83.	-	-	99.	0.255	1.	5.	-	-	5.	0.000	1.
34541.	151.	200.	416.	-	-	-	11.	20.	345.	-	-	-
34541.	127.	100.	289.	-	-	-	ND	-	-	-	-	-
34541.	120.	100.	543.	-	-	-	ND	-	-	-	-	-
34541.	77.	-	-	73.	0.067	1.	ND	-	-	-	-	-
34541.	114.	100.	690.	-	-	-	ND	-	-	-	-	-
34541.	84.	50.	284.	-	-	-	5.	20.	70.	-	-	-
34541.	67.	-	-	68.	0.071	1.	5.	-	-	5.	0.000	1.
34541.	33.	50.	180.	-	-	-	5.	20.	50.	-	-	-
34541.	80.	50.	278.	-	-	-	5.	20.	60.	-	-	-
34541.	50.	30.	70.	-	-	-	ND	20.	120.	-	-	-
34541.	24.	30.	70.	-	-	-	ND	20.	80.	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34541.	120.	-	-	125.	0.062	1.	ND	-	-	-	-	-
34541.	21.	30.	103.	-	-	-	ND	20.	105.	-	-	-
34541.	162.	100.	34.	-	-	-	5.	20.	0.	-	-	-
34541.	52.	-	-	54.	0.065	1.	5.	-	-	5.	0.000	1.
34541.	73.	100.	51.	-	-	-	5.	20.	0.	-	-	-
34541.	173.	100.	111.	-	-	-	5.	20.	30.	-	-	-
34541.	660.	500.	1301.	-	-	-	24.	20.	-35.	-	-	-
34541.	950.	100.	937.	-	-	-	5.	20.	30.	-	-	-
34541.	576.	100.	331.	-	-	-	ND	-	-	-	-	-
34541.	309.	100.	480.	-	-	-	ND	20.	30.	-	-	-
34561.	ND	-	-	-	-	-	5.	4.	0.	-	-	-
34561.	347.	-	-	-	-	-	ND	-	-	-	-	-
34561.	251.	-	-	-	-	-	ND	-	-	-	-	-
34561.	200.	-	-	200.	0.000	1.	ND	-	-	-	-	-
34561.	303.	-	-	-	-	-	ND	-	-	-	-	-
34561.	116.	-	-	-	-	-	ND	-	-	-	-	-
34561.	440.	-	-	-	-	-	5.	-	-	-	-	-
34561.	182.	-	-	185.	0.033	2.	5.	-	-	5.	0.000	1.
34561.	239.	-	-	-	-	-	5.	-	-	-	-	-
34561.	1008.	-	-	-	-	-	5.	-	-	-	-	-
34561.	261.	-	-	220.	0.239	1.	5.	-	-	5.	0.000	1.
34561.	71.	-	-	-	-	-	ND	-	-	-	-	-
34561.	61.	-	-	-	-	-	ND	-	-	-	-	-
34561.	52.	-	-	-	-	-	ND	-	-	-	-	-
34561.	823.	-	-	-	-	-	ND	-	-	-	-	-
34561.	42.	-	-	43.	0.232	2.	ND	-	-	-	-	-
34561.	40.	-	-	-	-	-	ND	-	-	-	-	-
34561.	459.	-	-	-	-	-	ND	-	-	-	-	-
34561.	136.	-	-	110.	0.188	2.	ND	-	-	-	-	-
34561.	234.	-	-	-	-	-	ND	-	-	-	-	-
34561.	410.	-	-	-	-	-	5.	-	-	-	-	-
34561.	8700.	-	-	-	-	-	17.	-	-	-	-	-
34561.	625.	-	-	578.	0.078	2.	5.	-	-	5.	0.000	2.
34561.	216.	-	-	-	-	-	ND	-	-	-	-	-
34561.	162.	-	-	-	-	-	ND	-	-	-	-	-
34561.	179.	50.	-36.	-	-	-	ND	-	-	-	-	-
34561.	49.	-	-	45.	0.126	1.	ND	-	-	-	-	-
34561.	100.	50.	-86.	-	-	-	1.	-	-	2.	1.139	1.
34561.	36.	500.	215.	-	-	-	ND	-	-	-	-	-
34561.	255.	500.	162.	-	-	-	ND	-	-	-	-	-
34561.	244.	-	-	210.	0.211	1.	ND	-	-	-	-	-
34561.	282.	500.	192.	-	-	-	ND	-	-	-	-	-
34561.	297.	220.	72.	-	-	-	5.	10.	120.	-	-	-
34561.	100.	-	-	111.	0.152	1.	5.	-	-	5.	0.000	1.
34561.	13.	20.	140.	-	-	-	5.	10.	100.	-	-	-
34561.	33.	20.	35.	-	-	-	ND	10.	140.	-	-	-
34561.	44.	20.	15.	-	-	-	ND	-	-	-	-	-
34561.	25.	20.	130.	-	-	-	5.	10.	0.	-	-	-
34561.	355.	-	-	376.	0.083	1.	ND	-	-	-	-	-
34561.	33.	20.	-15.	-	-	-	ND	10.	100.	-	-	-
34561.	187.	100.	-56.	-	-	-	5.	10.	0.	-	-	-
34561.	52.	-	-	50.	0.042	1.	1.	-	-	2.	1.139	1.
34561.	151.	100.	-87.	-	-	-	5.	10.	0.	-	-	-
34561.	73.	100.	205.	-	-	-	5.	10.	0.	-	-	-
34561.	467.	350.	220.	-	-	-	10.	40.	153.	-	-	-
34561.	203.	50.	-102.	-	-	-	5.	20.	90.	2.	1.138	1.
34561.	71.	50.	110.	-	-	-	5.	20.	55.	-	-	-
34561.	48.	50.	50.	-	-	-	ND	20.	75.	-	-	-
34561.	ND	50.	108.	-	-	-	ND	-	-	-	-	-
34371.	140000.	140000.	107.	-	-	-	ND	-	-	-	-	-
34371.	120000.	120000.	117.	-	-	-	ND	-	-	-	-	-
34371.	90000.	-	-	88488.	0.024	1.	ND	-	-	-	-	-
34371.	37000.	40000.	120.	-	-	-	ND	-	-	-	-	-
34371.	31000.	-	-	31984.	0.044	1.	ND	-	-	-	-	-
34371.	28000.	20000.	165.	-	-	-	ND	-	-	-	-	-
34371.	19000.	-	-	17972.	0.079	1.	ND	-	-	-	-	-
34371.	49200.	-	-	-	-	-	ND	-	-	-	-	-
34371.	36400.	-	-	-	-	-	ND	-	-	-	-	-
34371.	260000.	-	-	-	-	-	ND	-	-	-	-	-
34371.	88.	80.	28.	-	-	-	ND	-	-	-	-	-
34371.	330.	300.	390.	-	-	-	ND	-	-	-	-	-
34371.	170.	-	-	175.	0.040	1.	ND	-	-	-	-	-
34371.	160.	150.	27.	-	-	-	5.	1.	0.	-	-	-
34371.	140.	-	-	170.	0.335	2.	ND	-	-	-	-	-
34371.	170.	170.	135.	175.	0.040	1.	ND	-	-	-	-	-
34371.	67.	-	-	-	-	-	ND	-	-	-	-	-
34371.	84.	-	-	-	-	-	ND	-	-	-	-	-
34371.	88.	-	-	85.	0.041	1.	ND	-	-	-	-	-
34371.	100.	-	-	-	-	-	ND	-	-	-	-	-
34371.	368.	-	-	-	-	-	ND	-	-	-	-	-
34371.	336.	-	-	-	-	-	ND	-	-	-	-	-
34371.	158.	-	-	165.	0.072	2.	ND	-	-	-	-	-
34371.	124.	-	-	-	-	-	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34371.	200.	-	-	-	-	-	ND	-	-	-	-	-
34371.	171.	-	-	173.	0.016	1.	ND	-	-	-	-	-
34371.	223.	-	-	-	-	-	ND	-	-	-	-	-
34371.	186.	-	-	-	-	-	ND	-	-	-	-	-
34371.	121.	-	-	-	-	-	ND	-	-	-	-	-
34371.	150.	-	-	-	-	-	ND	-	-	-	-	-
34371.	158.	-	-	148.	0.068	2.	ND	-	-	-	-	-
34371.	159.	-	-	-	-	-	ND	-	-	-	-	-
34371.	170.	-	-	-	-	-	ND	-	-	-	-	-
34371.	230.	-	-	235.	0.056	2.	ND	-	-	-	-	-
34371.	180.	-	-	-	-	-	ND	-	-	-	-	-
34371.	94.	-	-	-	-	-	ND	-	-	-	-	-
34371.	220.	-	-	-	-	-	ND	-	-	-	-	-
34371.	200.	-	-	200.	0.000	2.	ND	-	-	-	-	-
34371.	314.	-	-	-	-	-	ND	-	-	-	-	-
34371.	500.	-	-	-	-	-	ND	-	-	-	-	-
34371.	59.	100.	63.	-	-	-	5.	20.	335.	-	-	-
34371.	42.	100.	17.	-	-	-	5.	20.	275.	-	-	-
34371.	51.	-	-	48.	0.073	1.	5.	-	-	5.	0.000	1.
34371.	49.	100.	209.	-	-	-	5.	20.	265.	-	-	-
34371.	342.	200.	215.	-	-	-	5.	20.	370.	-	-	-
34371.	314.	200.	270.	-	-	-	5.	20.	146.	-	-	-
34371.	301.	-	-	313.	0.054	1.	5.	-	-	2.	1.138	1.
34371.	153.	200.	213.	-	-	-	5.	20.	130.	-	-	-
34371.	157.	100.	166.	-	-	-	5.	20.	110.	-	-	-
34371.	156.	-	-	84.	0.879	1.	5.	-	-	5.	0.000	1.
34371.	95.	100.	199.	-	-	-	5.	20.	135.	-	-	-
34371.	119.	100.	270.	-	-	-	5.	20.	75.	-	-	-
34371.	67.	200.	79.	-	-	-	5.	20.	85.	-	-	-
34371.	63.	200.	95.	-	-	-	5.	20.	75.	-	-	-
34371.	68.	-	-	82.	0.258	1.	1.	-	-	2.	1.139	1.
34371.	41.	200.	153.	-	-	-	5.	20.	105.	-	-	-
34371.	74.	100.	198.	-	-	-	5.	20.	60.	-	-	-
34371.	99.	-	-	104.	0.075	1.	5.	-	-	2.	1.138	1.
34371.	114.	100.	156.	-	-	-	5.	20.	0.	-	-	-
34371.	72.	100.	70.	-	-	-	5.	20.	0.	-	-	-
34371.	94.	200.	175.	-	-	-	5.	20.	60.	-	-	-
34371.	329.	100.	369.	-	-	-	5.	20.	60.	-	-	-
34371.	323.	100.	445.	-	-	-	5.	20.	50.	-	-	-
34371.	715.	100.	845.	-	-	-	ND	20.	85.	-	-	-
34371.	ND	1000.	107.	-	-	-	ND	100.	74.	-	-	-
34371.	ND	1000.	110.	-	-	-	ND	100.	83.	-	-	-
34371.	ND	1000.	310.	-	-	-	ND	-	-	-	-	-
34371.	200.	200.	130.	-	-	-	ND	-	-	-	-	-
34371.	850.	850.	124.	-	-	-	5.	1.	0.	-	-	-
34371.	650.	-	-	665.	0.032	1.	ND	-	-	-	-	-
34371.	320.	300.	90.	-	-	-	ND	-	-	-	-	-
34371.	330.	-	-	325.	0.022	1.	ND	-	-	-	-	-
34371.	390.	500.	222.	-	-	-	ND	-	-	-	-	-
34371.	650.	-	-	477.	0.438	1.	ND	-	-	-	-	-
34371.	144.	165.	105.	-	-	-	ND	-	-	-	-	-
34371.	829.	303.	103.	-	-	-	ND	-	-	-	-	-
34371.	511.	-	-	518.	0.019	1.	ND	-	-	-	-	-
34371.	220.	207.	135.	-	-	-	ND	-	-	-	-	-
34371.	301.	-	-	291.	0.046	1.	ND	-	-	-	-	-
34371.	278.	246.	125.	-	-	-	ND	-	-	-	-	-
34371.	202.	-	-	205.	0.021	1.	ND	-	-	-	-	-
34371.	159.	-	-	-	-	-	ND	-	-	-	-	-
34371.	218.	-	-	-	-	-	ND	-	-	-	-	-
34371.	170.	-	-	167.	0.021	1.	ND	-	-	-	-	-
34371.	390.	100.	69.	-	-	-	ND	100.	117.	-	-	-
34371.	106.	-	-	108.	0.028	1.	ND	-	-	-	-	-
34371.	200.	1000.	103.	-	-	-	ND	20.	92.	-	-	-
34371.	128.	1000.	87.	-	-	-	ND	20.	96.	-	-	-
34371.	590.	-	-	467.	0.330	1.	ND	-	-	-	-	-
34371.	130.	1000.	89.	-	-	-	ND	20.	97.	-	-	-
34371.	107.	-	-	113.	0.081	1.	ND	20.	93.	-	-	-
34371.	110.	1000.	79.	-	-	-	ND	100.	100.	-	-	-
34371.	58.	-	-	73.	0.326	1.	ND	-	-	-	-	-
34371.	90.	1000.	91.	-	-	-	ND	100.	180.	-	-	-
34371.	160.	1000.	85.	-	-	-	ND	100.	100.	-	-	-
34371.	70.	-	-	58.	0.267	1.	ND	-	-	-	-	-
34371.	90.	5000.	58.	-	-	-	5.	100.	186.	-	-	-
34371.	640.	5000.	161.	-	-	-	ND	100.	100.	-	-	-
34371.	160.	-	-	212.	0.396	1.	ND	-	-	-	-	-
34371.	260.	5000.	183.	-	-	-	ND	100.	120.	-	-	-
34371.	770.	-	-	402.	0.918	1.	ND	-	-	-	-	-
34371.	120.	1000.	79.	-	-	-	ND	100.	120.	-	-	-
34371.	138.	-	-	142.	0.045	1.	ND	-	-	-	-	-
34371.	227.	1000.	137.	-	-	-	ND	100.	96.	-	-	-
34371.	250.	1000.	125.	-	-	-	ND	20.	105.	-	-	-
34371.	160.	-	-	282.	0.893	1.	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34371.	430.	1000.	177.	-	-	-	ND	200.	105.	-	-	-
34371.	290.	-	-	295.	0.024	1.	ND	-	-	-	-	-
34371.	640.	10000.	174.	-	-	-	ND	100.	96.	-	-	-
34	80.	-	-	70.	0.180	1.	ND	-	-	-	-	-
344.	46.	-	-	-	-	-	29.	-	-	-	-	-
34423.	95.	-	-	-	-	-	94.	-	-	-	-	-
34423.	21.	-	-	-	-	-	120.	-	-	-	-	-
34423.	60.	50.	-110.	-	-	-	ND	-	-	-	-	-
34423.	41.	-	-	14.	1.468	1.	5.	-	-	8.	0.619	1.
34423.	130.	100.	220.	-	-	-	5.	1.	0.	-	-	-
34423.	1.	-	-	12.	4.359	2.	5.	-	-	9.	1.015	2.
34423.	650.	650.	162.	57.	3.442	1.	5.	5.	280.	11.	1.109	1.
34423.	ND	-	-	-	-	-	5.	-	-	-	-	-
34423.	ND	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	2.
34423.	ND	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	5.	0.000	2.	5.	-	-	5.	0.000	1.
34423.	52.	-	-	-	-	-	ND	-	-	-	-	-
34423.	40.	-	-	-	-	-	5.	-	-	-	-	-
34423.	12.	-	-	12.	0.000	1.	5.	-	-	5.	0.000	1.
34423.	11.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	15.	-	-	17.	0.122	2.	5.	-	-	5.	0.000	2.
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	5.	0.000	2.	5.	-	-	5.	0.000	2.
34423	5.	-	-	-	-	-	5.	-	-	-	-	-
34	5.	-	-	-	-	-	40.	-	-	-	-	-
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	5.	0.000	2.	5.	-	-	5.	0.000	2.
34423.	28.	-	-	-	-	-	5.	-	-	-	-	-
34423.	5.	-	-	-	-	-	5.	-	-	-	-	-
34423.	41.	225.	58.	-	-	-	28.	22.	45.	-	-	-
34423.	36.	225.	60.	-	-	-	16.	22.	100.	-	-	-
34423.	18.	-	-	21.	0.203	1.	20.	-	-	18.	0.158	1.
34423.	22.	225.	231.	-	-	-	35.	22.	14.	-	-	-
34423.	18.	23.	274.	-	-	-	17.	23.	322.	-	-	-
34423.	11.	23.	535.	-	-	-	5.	23.	87.	-	-	-
34423.	21.	-	-	21.	0.000	1.	10.	-	-	10.	0.068	1.
34423.	43.	23.	174.	-	-	-	13.	23.	65.	-	-	-
34423.	5.	23.	139.	-	-	-	20.	23.	-65.	-	-	-
34423.	12.	-	-	8.	0.619	1.	74.	-	-	79.	0.098	1.
34423.	5.	22.	118.	-	-	-	28.	23.	-100.	-	-	-
34423.	5.	22.	159.	-	-	-	17.	23.	-30.	-	-	-
34423.	20.	23.	139.	-	-	-	5.	23.	70.	-	-	-
34423.	13.	23.	91.	-	-	-	5.	23.	52.	-	-	-
34423.	38.	-	-	36.	0.058	1.	15.	-	-	17.	0.204	1.
34423.	87.	23.	113.	-	-	-	5.	23.	91.	-	-	-
34423.	5.	23.	139.	-	-	-	5.	23.	26.	-	-	-
34423.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	1.
34423.	5.	23.	0.	-	-	-	5.	23.	0.	-	-	-
34423.	5.	23.	0.	-	-	-	5.	23.	65.	-	-	-
34423.	5.	20.	425.	-	-	-	5.	22.	91.	-	-	-
34423.	5.	20.	0.	-	-	-	5.	337.	31.	-	-	-
34423.	5.	20.	170.	-	-	-	36.	337.	62.	-	-	-
34423.	5.	20.	145.	-	-	-	26.	22.	473.	-	-	-
34423.	230.	230.	130.	-	-	-	64.	60.	60.	-	-	-
34423.	1900.	-	-	816.	1.196	1.	ND	-	-	-	-	-
34423.	290.	300.	3103.	-	-	-	5.	-	-	-	-	-
34423.	420.	-	-	2510.	2.528	1.	ND	-	-	-	-	-
34423.	570.	750.	2324.	-	-	-	5.	-	-	-	-	-
34423.	330.	-	-	182.	0.844	1.	14.	-	-	8.	0.727	1.
34423.	5.	-	-	-	-	-	ND	-	-	-	-	-
34423.	5.	89.	119.	-	-	-	ND	-	-	-	-	-
34423.	12.	-	-	11.	0.128	1.	ND	-	-	-	-	-
34423.	ND	1000.	55.	-	-	-	ND	-	-	-	-	-
34423.	ND	10000.	61.	-	-	-	ND	-	-	-	-	-
34516.	58.	60.	87.	-	-	-	ND	-	-	-	-	-
34516.	ND	-	-	-	-	-	5.	-	-	3.	0.929	2.
34516.	5.	20.	45.	-	-	-	ND	-	-	-	-	-
34516.	ND	20.	10.	-	-	-	ND	-	-	-	-	-
34516.	ND	20.	370.	-	-	-	ND	-	-	-	-	-
34475.	5.	10.	170.	-	-	-	ND	-	-	-	-	-
34475.	ND	-	-	-	-	-	5.	-	-	-	-	-
34475.	78.	-	-	68.	0.176	1.	5.	-	-	5.	0.000	1.
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34475.	ND	-	-	-	-	-	5.	-	-	-	-	
34475.	5.	-	-	2.	0.929	2.	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	3.	0.929	2.	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	20.	90.	-	-	-	ND	-	-	-	-	-
34475.	5.	20.	45.	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34475.	5.	20.	270.	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	1.	-	-	2.	1.139	1.	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34475.	5.	-	-	-	-	-	ND	-	-	-	-	-
34475.	5.	20.	120.	-	-	-	ND	-	-	-	-	-
34475.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34475.	5.	20.	135.	-	-	-	ND	-	-	-	-	-
34475.	5.	20.	145.	-	-	-	ND	-	-	-	-	-
34475.	5.	20.	290.	-	-	-	ND	20.	130.	-	-	-
34475.	1.	-	-	2.	1.139	1.	1.	-	-	2.	1.139	1.
34475.	5.	20.	360.	-	-	-	ND	20.	80.	-	-	-
34475.	5.	20.	395.	-	-	-	ND	20.	90.	-	-	-
34475.	ND	20.	340.	-	-	-	ND	20.	95.	-	-	-
34475.	14.	-	-	8.	0.727	1.	ND	-	-	-	-	-
34475.	ND	1000.	110.	-	-	-	ND	200.	95.	-	-	-
34475.	ND	-	-	-	-	-	ND	100.	84.	-	-	-
34506.	ND	-	-	-	-	-	5.	1.	0.	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	5.	-	-	-	-	-	ND	-	-	-	-	-
34506.	19.	50.	68.	-	-	-	ND	-	-	-	-	-
34506.	5.	50.	88.	-	-	-	5.	20.	235.	-	-	-
34506.	13.	-	-	12.	0.118	1.	5.	-	-	5.	0.000	1.
34506.	5.	50.	206.	-	-	-	ND	20.	285.	-	-	-
34506.	14.	20.	255.	-	-	-	5.	20.	530.	-	-	-
34506.	5.	20.	270.	-	-	-	ND	20.	160.	-	-	-
34506.	39.	-	-	43.	0.147	1.	5.	-	-	5.	0.000	1.
34506.	18.	20.	285.	-	-	-	5.	20.	145.	-	-	-
34506.	ND	20.	140.	-	-	-	5.	20.	125.	-	-	-
34506.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	1.
34506.	5.	20.	145.	-	-	-	5.	20.	105.	-	-	-
34506.	5.	20.	215.	-	-	-	5.	20.	110.	-	-	-
34506.	5.	20.	120.	-	-	-	5.	20.	70.	-	-	-
34506.	5.	20.	110.	-	-	-	5.	20.	0.	-	-	-
34506.	10.	-	-	7.	0.491	1.	5.	-	-	7.	0.557	1.
34506.	12.	20.	85.	-	-	-	ND	20.	35.	-	-	-
34506.	12.	20.	70.	-	-	-	5.	20.	30.	-	-	-
34506.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	1.
34506.	5.	20.	105.	-	-	-	5.	20.	0.	-	-	-
34506.	10.	20.	135.	-	-	-	5.	20.	0.	-	-	-
34506.	5.	20.	295.	-	-	-	5.	20.	55.	-	-	-
34506.	12.	20.	390.	-	-	-	1.	20.	55.	2.	1.139	1.
34506.	10.	20.	315.	-	-	-	5.	20.	30.	-	-	-
34506.	19.	20.	360.	-	-	-	ND	20.	60.	-	-	-
34506.	ND	50.	96.	-	-	-	ND	20.	305.	-	-	-
34511.	ND	-	-	-	-	-	5.	1.	0.	-	-	-
34511.	24.	-	-	-	-	-	ND	-	-	-	-	-
34511.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34511.	5.	-	-	-	-	-	ND	-	-	-	-	-
34511.	37.	-	-	-	-	-	ND	-	-	-	-	-
34511.	64.	-	-	-	-	-	ND	-	-	-	-	-
34511.	10.	-	-	5.	1.436	2.	ND	-	-	-	-	-
34511.	11.	-	-	-	-	-	ND	-	-	-	-	-
34511.	5.	-	-	-	-	-	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34511.	~~5.~~		-	~~5.~~	~~0.000~~	~~2.~~	~~ND~~	-	-	-	-	-
34511.	13.	-	-	-	-	-	ND	-	-	-	-	-
34511.	14.	-	-	-	-	-	ND	-	-	-	-	-
34511.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
34511.	14.	-	-	-	-	-	ND	-	-	-	-	-
34511.	41.	20.	-150.	-	-	-	ND	-	-	-	-	-
34511.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34511.	ND	20.	65.	-		-	ND	-	-	-	-	-
34511.	ND	20.	90.	-	-	-	ND	-	-	-	-	-
39180.	41.	40.	148.	-	-	-	ND	-	-	-	-	-
39180.	11.	-	-	13.	0.219	1.	ND	-	-	-	-	-
39180.	24.	20.	-10.	-	-	-	ND	-	-	-	-	-
39180.	10.	-	-	5.	1.385	2.	ND	-	-	-	-	-
39180.	23.	-	-	23.	0.030	1.	ND	-	-	-	-	-
39180.	5.	-	-	-	-	-	ND	-	-	-	-	-
39180.	5.	-	-	-	-	-	ND	-	-	-	-	-
39180.	5.	-	-	-	-	-	ND	-	-	-	-	-
39180.	5.	-	-	-	-	-	ND	-	-	-	-	-
39180.	5.	-	-	-	-	-	ND	-	-	-	-	-
39180.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-
39180.	5.	-	-	-	-	-	ND	-	-	-	-	-
39180.	5.	20.	105.	-	-	-	5.	20.	225.	-	-	-
39180.	18.	-	-	19.	0.074	1.	5.	-	-	5.	0.000	1.
39180.	5.	20.	270.	-	-	-	ND	20.	300.	-	-	-
39180.	5.	20.	395.	-	-	-	ND	20.	215.	-	-	-
39180.	ND	20.	465.	-	-	-	5.	20.	230.	-	-	-
39180.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	1.
39180.	ND	20.	555.	-	-	-	5.	20.	210.	-	-	-
39180.	ND	-	-	-	-	-	5.	20.	80.	-	-	-
39180.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
39180.	5.	-	-	-	-	-	5.	20.	90.	-	-	-
39180.	ND	-	-	-	-	-	5.	20.	95.	-	-	-
39180.	5.	20.	25.	-	-	-	5.	20.	95.	-	-	-
39180.	5.	20.	90.	-	-	-	ND	20.	110.	-	-	-
39180.	5.	-	-	5.	0.000	1.	5.	-	-	2.	1.138	1.
39180.	5.	20.	105.	-	-	-	5.	20.	160.	-	-	-
39180.	5.	20.	90.	-	-	-	1.	20.	50.	-	-	-
39180.	5.	-	-	5.	0.000	1.	1.	-	-	2.	1.139	1.
39180.	5.	20.	145.	-	-	-	5.	20.	0.	-	-	-
39180.	5.	20.	195.	-	-	-	5.	20.	0.	-	-	-
39180.	5.	20.	300.	-	-	-	5.	20.	110.	-	-	-
39180.	5.	20.	410.	-	-	-	5.	20.	90.	2.	1.138	1.
39180.	5.	20.	285.	-	-	-	5.	20.	45.	-	-	-
39180.	5.	20.	285.	-	-	-	ND	20.	65.	-	-	-
39180.	ND	-	-	-	-	-	ND	20.	300.	-	-	-
39180.	13.	13.	138.	-	-	-	5.	1.	0.	-	-	-
39180.	ND	1000.	100.	-	-	-	ND	200.	100.	-	-	-
39180.	ND	10000.	110.	-	-	-	ND	-	-	-	-	-
34488.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
34488.	ND	-	-	-	-	-	5.	20.	210.	-	-	-
34488.	ND	-	-	-	-	-	5.	20.	225.	-	-	-
34488.	ND	-	-	-	-	-	26.	20.	-35.	-	-	-
34488.	ND	-	-	-	-	-	ND	20.	305.	-	-	-
34488.	ND	-	-	-	-	-	ND	20.	80.	-	-	-
34498.	ND	-	-	-	-	-	ND	20.	55.	-	-	-
34488.	ND	-	-	-	-	-	ND	20.	65.	-	-	-
34010.	7000.	7000.	214.	-	-	-	5.	-	-	-	-	-
34010.	7500.	8000.	144.	-	-	-	5.	-	-	-	-	-
34010.	6100.	-	-	6199.	0.023	1.	ND	-	-	-	-	-
34010.	3500.	4000.	145.	-	-	-	5.	-	-	-	-	-
34010.	3200.	-	-	3347.	0.063	1.	ND	-	-	-	-	-
34010.	2500.	4000.	130.	-	-	-	ND	-	-	-	-	-
34010.	2400.	-	-	2592.	0.109	1.	ND	-	-	-	-	-
34010.	2130.	-	-	-	-	-	ND	21.	96.	-	-	-
34010.	1500.	-	-	-	-	-	ND	22.	100.	-	-	-
34010.	3100.	-	-	-	-	-	ND	-	-	-	-	-
34010.	1700.	1500.	40.	-	-	-	ND	-	-	-	-	-
34010.	5300.	5000.	94.	-	-	-	ND	-	-	-	-	-
34010.	3500.	-	-	2439.	0.511	1.	5.	-	-	5.	0.000	1.
34010.	3500.	5000.	120.	-	-	-	5.	1.	0.	-	-	-
34010.	1600.	-	-	1690.	0.151	2.	ND	-	-	-	-	-
34010.	2600.	2000.	85.	2450.	0.087	1.	5.	2.	0.	5.	0.000	1.
34010.	1330.	-	-	-	-	-	ND	-	-	-	-	-
34010.	1900.	-	-	-	-	-	ND	-	-	-	-	-
34010.	2200.	-	-	2087.	0.074	1.	ND	-	-	-	-	-
34010.	1730.	-	-	-	-	-	ND	-	-	-	-	-
34010.	3900.	-	-	-	-	-	5.	-	-	-	-	-
34010.	3370.	-	-	-	-	-	5.	-	-	-	-	-
34010.	2440.	-	-	2490.	0.017	2.	1.	-	-	2.	1.139	1.
34010.	2400.	-	-	-	-	-	ND	-	-	-	-	-
34010.	3658.	-	-	-	-	-	ND	-	-	-	-	-
34010.	2900.	-	-	2865.	0.017	1.	5.	-	-	5.	0.000	1.

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34010.	5040.		-	-	-	-	ND	-	-	-	-	-
34010.	4900.	-			-	-	5.	-	-	-	-	-
34010.	6300.	-	-	-	-	-	ND	-	-	-	-	-
34010.	6900.	-	-	-	-	-	ND	-	-	-	.	-
34010.	5750.	-	-	5600.	0.039	2.	ND	-	-	-	.	-
34010.	4840.	-	-	-	-	-	ND	-	-	-	-	-
34010.	3160.	-	-	-	-	-	ND	-	-	-	-	-
34010.	3990.	-	-	4100.	0.061	2.	ND	-	-	-	-	-
34010.	3450.	-	-	-	-	-	ND	-	-	-	-	-
34010.	4480.	-	-	-	-	-	ND	-	-	-	-	-
34010.	7600.	-	-	-	-	-	ND	-	-	.	-	-
34010.	5400.	-	-	5500.	0.018	2.	5.	-	-	4.	0.929	2.
34010.	6140.	-	-	-	-	-	ND	-	-	-	-	-
34010.	5560.	-	-	-	-	-	5.	-	-		-	-
34010.	1555.	1500.	86.	-	-	-	5.	20.	305.	-	-	-
34010.	5470.	4000.	15.	-	-	-	5.	20.	270.	-	-	-
34010.	6640.	-	-	4964.	0.412	1.	5.	-	-	5.	0.000	1.
34010.	7190.	5000.	-51.	-	-	-	5.	20.	230.	-	-	-
34010.	2830.	-	-	-	-	-	5.	20.	285.	-	-	-
34010.	2490.	2000.	247.	-	-	-	5.	20.	140.	-	-	-
34010.	5260.	-	-	4999.	0.072	1.	5.	-	-	5.	0.000	1.
34010.	2920.	2000.	151.	-	-	-	5.	20.	140.	-	-	-
34010.	2270.	3000.	131.	-	-	-	5.	20.	250.	-	-	-
34010.	2250.	-	-	1962.	0.194	1.	5.	-	-	5.	0.000	1.
34010.	2800.	3000.	166.	-	-	-	5.	20.	345.	-	-	-
34010.	6120.	-	-	-	-	-	5.	20.	200.	-	-	-
34010.	3566.	4000.	82.	-	-	-	5.	20.	85.	-	-	-
34010.	3595.	-	-	-	-	-	5.	20.	75.	-	-	-
34010.	3813.	-	-	-	-	-	5.	-	-	5.	0.000	1.
34010.	2831.	-	-	-	-	-	5.	20.	125.	-	-	-
34010.	975.	900.	59.	-	-	-	5.	40.	65.	-	-	-
34010.	1420.	-	-	1655.	0.217	1.	5.	-	-	5.	0.000	1.
34010.	925.	900.	398.	-	-	-	5.	40.	18.	-	-	-
34010.	888.	900.	94.	-	-	-	5.	40.	30.	-	-	-
34010.	8245.	1000.	120.	-	-	-	5.	20.	85.	-	-	-
34010.	4413.	1000.	11.	-	-	-	5.	20.	65.	-	-	-
34010.	5303.	1000.	-19.	-	-	-	5.	20.	60.	-	-	-
34010.	4410.	1000.	265.	-	-	-	20.	20.	-10.	-	-	-
34010.	10000.	15000.	80.	-	-	-	5.	1.5	0.	-	-	-
34010.	7000.	6000.	67.	-	-	-	5.	4.	0.	-	-	-
34010.	5600.	-	-	5600.	0.000	1.	5.	-	-	7.	0.557	1.
34010.	8000.	10000.	80.	-	-	-	5.	8.	100.	-	-	-
34010.	13000.	-	-	13000.	0.000	1.	ND	-	-	-	-	-
34010.	9000.	10000.	90.	-	-	-	ND	-	-	-	-	-
34010.	36000.	-	-	38418.	0.092	1.	ND	-	-	-	-	-
34010.	13700.	8610.	74.	-	-	-	ND	-	-	-	-	-
34010.	13100.	6300.	113.	-	-	-	ND	-	-	-	-	-
34010.	5200.	-	-	5299.	0.027	1.	1.	-	-	2.	1.139	1.
34010.	9400.	8610.	93.	-	-	-	ND	-	-	-	-	-
34010.	12400.	-	-	12198.	0.023	1.	5.	-	-	2.	1.138	1.
34010.	17400.	11500.	116.	-	-	-	1.	-	-	2.	1.139	1.
34010.	46500.	-	-	44845.	0.020	1.	ND	-	-	-	-	-
34010.	3400.	-	-	-	-	-	ND	-	-	-	-	-
34010.	2800.	6000.	92.	-	-	-	ND	-	-	-	-	-
34010.	16000.	-	-	16000.	0.000	1.	ND	-	-	-	-	-
34010.	6200.	100.	-600.	-	-	-	ND	100.	86.	.	-	-
34010.	3500.	-	-	3762.	0.094	1.	ND	-	-	-	-	-
34010.	7600.	1000.	120.	-	-	-	ND	20.	72.	-	-	-
34010.	7400.	1000.	60.	-	-	-	ND	20.	78.	-	-	-
34010.	4800.	-	-	5671.	0.236	1.	ND	-	-	-	-	-
34010.	6800.	1000.	34.	-	-	-	ND	20.	79.	-	-	-
34010.	6200.	-	-	6493.	0.065	1.	ND	20.	77.	-	-	-
34010.	9800.	1000.	-130.	-	-	-	ND	100.	99.	-	-	-
34010.	2800.	-	-	3510.	0.320	1.	ND	-	-	-	-	-
34010.	4100.	1000.	50.	-	-	-	ND	100.	150.	-	-	-
34010.	26000.	1000.	-100.	-	-	-	21.	100.	112.	-	-	-
34010.	4500.	-	-	3765.	0.252	1.	22.	-	-	18.	0.271	1.
34010.	3400.	5000.	332.	-	-	-	37.	100.	143.	-	-	-
34010.	7300.	5000.	154.	-	-	-	ND	100.	130.	-	-	-
34010.	10000.	-	-	12649.	0.332	1.	ND	-	-	-	-	-
34010.	35000.	5000.	-380.	-	-	-	ND	100.	126.	-	-	-
34010.	7600.	-	-	12930.	0.752	1.	ND	-	-	-	-	-
34010.	5310.	1000.	49.	-	-	-	ND	100.	120.	-	-	-
34010.	2373.	-	-	2894.	0.281	1.	13.	-	-	13.	0.053	1.
34010.	11060.	1000.	-366.	-	-	-	12.	100.	100.	-	-	-
34010.	4700.	1000.	-209.	-	-	-	15.	100.	89.	-	-	-
34010.	2100.	-	-	2337.	0.151	1.	ND	-	-	-	-	-
34010.	4800.	7000.	74.	-	-	-	ND	100.	90.	-	-	-
34010.	9300.	10000.	17.	-	-	-	ND	-	-	-	-	-
34010.	6650.	-	-	7271.	0.126	1.	74.	-	-	66.	0.160	1.
34010.	15000.	10000.	100.	-	-	-	ND	20.	106.	-	-	-
34010.	ND	-	-	-	-	-	240.	-	-	235.	0.030	1.

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34010.	8100.	-	-	6170.	0.385	1.	16.	-	-	14.	0.204	1.
34010.	13000.	1000.	-	-	-	-	ND	200.	106.	-	-	-
34010.	6300.	-	-	6148.	0.034	1.	5.	-	-	5.	0.000	1.
34010.	16000.	60000.	55.	-	-	-	ND	100.	97.	-	-	-
34010.	4274.	-	-	4482.	0.067	1.	ND	-	-	-	-	-
39175.	12.	-	-	-	-	-	ND	-	-	-	-	-
39175.	5.	-	-	-	-	-	ND	-	-	-	-	-
39175.	5.	-	-	-	-	-	ND	-	-	-	-	-
39175.	5.	-	-	5.	0.000	2.	ND	-	-	-	-	-

BASE/NEUTRAL TOXIC ORGANIC POLLUTANTS

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34205.	260.	260.	58.	-	-	-	5.	-	-	-	-	-
34205.	140.	140.	50.	-	-	-	ND	-	-	-	-	-
34205.	78.	-	-	79.	0.018	1.	ND	-	-	-	-	-
34205.	190.	190.	89.	-	-	-	1.	-	-	2.	1.139	1.
34205.	330.	-	-	309.	0.091	1.	ND	-	-	-	-	-
34205.	420.	160.	138.	-	-	-	5.	-	-	2.	1.138	1.
34205.	170.	-	-	184.	0.115	1.	ND	-	-	-	-	-
34205.	120.	-	-	-	-	-	ND	-	-	-	-	-
34205.	160.	-	-	-	-	-	ND	-	-	-	-	-
34200.	190.	190.	105.	-	-	-	5.	-	-	-	-	-
34200.	110.	110.	91.	-	-	-	ND	-	-	-	-	-
34200.	72.	-	-	73.	0.019	1.	ND	-	-	-	-	-
34200.	186.	180.	91.	-	-	-	1.	-	-	2.	1.139	1.
34200.	220.	-	-	215.	0.033	1.	5.	-	-	2.	1.138	1.
34200.	180.	90.	222.	-	-	-	1.	-	-	2.	1.139	1.
34200.	110.	-	-	120.	0.118	1.	ND	-	-	-	-	-
34200.	86.	-	-	-	-	-	ND	-	-	-	-	-
34200.	130.	-	-	-	-	-	ND	-	-	-	-	-
34200.	ND	-	-	-	-	-	5.	1.5	0.	-	-	-
34200.	110.	-	-	103.	0.096	1.	ND	-	-	-	-	-
34220./34461.	460.	460.	111.	-	-	-	15.	10.	80.	-	-	-
34220./34461.	250.	250.	100.	-	-	-	5.	-	-	2.	1.138	1.
34220./34461.	120.	-	-	139.	0.203	1.	ND	-	-	-	-	-
34220./34461.	370.	360.	92.	-	-	-	1.	-	-	2.	1.139	1.
34220./34461.	1100.	-	-	1049.	0.067	1.	ND	-	-	-	-	-
34220./34461.	1100.	540.	148.	-	-	-	5.	-	-	5.	0.000	1.
34220./34461.	560.	-	-	599.	0.094	1.	5.	-	-	2.	1.138	1.
34220./34461.	190.	-	-	-	-	-	ND	-	-	-	-	-
34220./34461.	230.	-	-	-	-	-	ND	-	-	-	-	-
34220./34461.	118.	-	-	-	-	-	ND	-	-	-	-	-
34220./34461.	12.	11.	-56.	-	-	-	5.	2.5	0.	-	-	-
34220./34461.	5.	1.	0.	-	-	-	ND	-	-	-	-	-
34220./34461.	5.	8.	75.	-	-	-	5.	1.	0.	-	-	-
34220./34461.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34526./34320.	98.	100.	92.	-	-	-	76.	80.	80.	-	-	-
34526./34320.	22.	20.	80.	-	-	-	5.	-	-	10.	1.048	1.
34526./34320.	20.	-	-	23.	0.186	1.	1.	-	-	4.	1.813	1.
34526./34320.	62.	60.	47.	-	-	-	5.	-	-	5.	0.000	1.
34526./34320.	78.	-	-	88.	0.176	1.	5.	-	-	7.	0.491	1.
34526./34320.	180.	90.	167.	-	-	-	5.	-	-	5.	0.000	1.
34526./34320.	120.	-	-	115.	0.062	1.	5.	-	-	5.	0.000	1.
34526./34320.	23.	-	-	-	-	-	ND	-	-	-	-	-
34526./34320.	31.	-	-	-	-	-	ND	-	-	-	-	-
34526./34320.	5.	2.	0.	-	-	-	ND	-	-	-	-	-
34230./34242.	50.	-	-	-	-	-	89.	98.	68.	-	-	-
34230./34242.	18.	20.	90.	-	-	-	21.	-	-	5.	2.153	1.
34230./34242.	5.	-	-	8.	0.728	1.	5.	-	-	8.	0.619	1.
34230./34242.	30.	30.	17.	-	-	-	16.	-	-	20.	0.287	1.
34230./34242.	28.	-	-	33.	0.252	1.	5.	-	-	10.	1.048	1.
34230./34242.	92.	50.	456.	-	-	-	5.	-	-	8.	0.676	1.
34230./34242.	92.	-	-	94.	0.038	1.	5.	-	-	5.	0.000	1.
34230./34242.	13.	-	-	-	-	-	ND	-	-	-	-	-
34230./34242.	17.	-	-	-	-	-	ND	-	-	-	-	-
34230./34242.	5.	3.2	0.	-	-	-	ND	-	-	-	-	-
34247.	73.	70.	26.	-	-	-	65.	60.	42.	-	-	-
34247.	21.	20.	15.	-	-	-	ND	-	-	-	-	-
34247.	5.	-	-	5.	0.000	1.	1.	-	-	2.	1.139	1.
34247.	48.	50.	8.	-	-	-	ND	-	-	-	-	-
34247.	1.	-	-	5.	2.366	1.	ND	-	-	-	-	-
34247.	62.	30.	727.	-	-	-	1.	-	-	2.	1.139	1.
34247.	44.	-	-	7.	2.676	1.	5.	-	-	2.	1.138	1.
34247.	13.	-	-	-	-	-	ND	-	-	-	-	-
34247.	5.	7.	71.	-	-	-	ND	-	-	-	-	-
34247.	44.	370.	99.	-	-	-	ND	-	-	-	-	-
34247.	24.	-	-	-	-	-	ND	-	-	-	-	-
34247.	5.	-	-	-	-	-	ND	-	-	-	-	-
39100.	18.	-	-	-	-	-	5.	-	-	-	-	-
39100.	5.	-	-	-	-	-	5.	-	-	5.	0.000	1.
39100.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
39100.	5.	-	-	-	-	-	5.	-	-	5.	0.000	1.
39100.	42.	-	-	15.	1.503	1.	1.	-	-	2.	1.139	1.
39100.	40.	-	-	-	-	-	5.	-	-	5.	0.000	1.
39100.	10.	-	-	11.	0.186	1.	5.	-	-	2.	1.138	1.
39100.	2300.	2300.	39.	-	-	-	220.	220.	36.	-	-	-
39100.	880.	900.	69.	-	-	-	ND	-	-	-	-	-
39100.	1300.	-	-	1300.	0.000	1.	180.	-	-	170.	0.083	1.
39100.	500.	500.	20.	-	-	-	30.	30.	333.	-	-	-
39100.	94.	-	-	97.	0.044	1.	5.	-	-	5.	0.000	1.
39100.	180.	180.	33.	-	-	-	5.	6.	0.	-	-	-
39100.	260.	-	-	250.	0.057	1.	10.	-	-	7.	0.491	1.
39100.	3060.	2120.	-11.	-	-	-	19.	53.	40.	-	-	-
39100.	4550.	5270.	46.	-	-	-	101.	53.	8.	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
39100.	2000.	-	-	1924.	0.055	1.	93.	-	-	112.	0.269	1.
39100.	495.	1050.	26.	-	-	-	11.	63.	-8.	-	-	-
39100.	214.	-	-	153.	0.477	1.	11.	-	-	11.	0.062	1.
39100.	211.	354.	89.	-	-	-	10.	-	-	7.	0.491	1.
39100.	7[illegible]	-	-	706.	0.132	1.	5.	-	-	-	-	-
39100.	2600.	-	-	-	-	-	ND	-	-	-	-	-
39100.	250.	-	-	-	-	-	ND	-	-	-	-	-
39100.	62.	-	-	-	-	-	360.	-	-	-	-	-
39100.	11000.	-	-	-	-	-	130.	-	-	-	-	-
39100.	1400.	-	-	-	-	-	320.	-	-	-	-	-
39100.	9050.	-	-	-	-	-	140.	-	-	-	-	-
39100.	33000.	-	-	-	-	-	104.	-	-	-	-	-
39100.	300.	-	-	-	-	-	15.	50.	4.	-	-	-
39100.	450.	1000.	85.	-	-	-	80.	50.	-90.	-	-	-
39100.	220.	-	-	220.	0.000	1.	20.	-	-	18.	0.115	1.
39100.	89.	1000.	46.	-	-	-	19.	50.	4.	-	-	-
39100.	84.	-	-	80.	0.062	1.	13.	-	-	15.	0.190	1.
39100.	260.	-	-	-	-	-	21.	50.	12.	-	-	-
39100.	240.	1000.	-4.	-	-	-	15.	-	-	15.	0.046	1.
39100.	27.	1000.	101.	-	-	-	17.	50.	-2.	-	-	-
39100.	210.	1000.	-13.	-	-	-	5.	50.	30.	-	-	-
39100.	26.	-	-	11.	1.165	1.	5.	-	-	8.	0.676	1.
39100.	78.	1000.	45.	-	-	-	52.	50.	136.	-	-	-
39100.	76.	1000.	22.	-	-	-	57.	50.	54.	-	-	-
39100.	92.	-	-	88.	0.056	1.	60.	-	-	95.	0.648	1.
39100.	110.	1000.	84.	-	-	-	85.	50.	170.	-	-	-
39100.	47.	-	-	49.	0.072	1.	20.	-	-	21.	0.067	1.
39100.	140.	-	-	159.	0.178	1.	52.	-	-	64.	0.287	1.
39100.	970.	1000.	49.	-	-	-	53.	50.	0.	-	-	-
39100.	240.	-	-	214.	0.165	1.	170.	-	-	111.	0.598	1.
39100.	210.	1000.	70.	-	-	-	150.	50.	60.	-	-	-
39100.	126.	-	-	128.	0.022	1.	148.	-	-	151.	0.033	1.
34292.	5.	-	-	-	-	-	ND	-	-	-	-	-
34292.	ND	-	-	-	-	-	1.	-	-	2.	1.139	1.
34292.	26.	25.	12.	-	-	-	ND	-	-	-	-	-
34292.	120.	-	-	45.	1.381	1.	ND	-	-	-	-	-
34292.	5.	6.	0.	-	-	-	ND	-	-	-	-	-
34292.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	1.
34320.	ND	-	-	-	-	-	5.	-	-	2.	1.138	1.
34320.	ND	-	-	-	-	-	ND	2.	100.	-	-	-
34556.	29.	30.	-97.	-	-	-	75.	80.	231.	-	-	-
39110.	5.	-	-	-	-	-	5.	-	-	-	-	-
39110.	5.	-	-	-	-	-	5.	-	-	5.	0.000	1.
39110.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
39110.	5.	-	-	-	-	-	1.	-	-	2.	1.139	1.
39110.	5.	-	-	5.	0.000	1.	1.	-	-	2.	1.139	1.
39110.	5.	-	-	-	-	-	5.	-	-	5.	0.000	1.
39110.	5.	-	-	2.	1.138	1.	5.	-	-	2.	1.138	1.
39110.	ND	-	-	-	-	-	ND	56.	80.	-	-	-
39110.	420.	425.	5.	-	-	-	5.	5.	160.	-	-	-
39110.	460.	450.	22.	-	-	-	130.	130.	69.	-	-	-
39110.	1800.	-	-	1897.	0.074	1.	5.	-	-	5.	0.000	1.
39110.	210.	200.	50.	-	-	-	5.	6.	0.	-	-	-
39110.	110.	-	-	115.	0.062	1.	5.	-	-	5.	0.000	1.
39110.	23.	20.	85.	-	-	-	5.	1.	0.	-	-	-
39110.	73.	-	-	79.	0.116	1.	5.	-	-	5.	0.000	1.
39110.	332.	200.	-14.	-	-	-	5.	-	-	-	-	-
39110.	532.	510.	44.	-	-	-	36.	51.	22.	-	-	-
39110.	2270.	-	-	2300.	0.018	1.	ND	-	-	-	-	-
39110.	600.	2050.	55.	-	-	-	ND	-	-	-	-	-
39110.	118.	-	-	105.	0.161	1.	ND	-	-	-	-	-
39110.	21.	88.	92.	-	-	-	ND	-	-	-	-	-
39110.	108.	-	-	127.	0.232	1.	ND	-	-	-	-	-
39110.	300.	-	-	-	-	-	ND	-	-	-	-	-
39110.	5.	-	-	-	-	-	ND	-	-	-	-	-
39110.	140.	-	-	-	-	-	ND	-	-	-	-	-
39110.	1600.	-	-	-	-	-	ND	-	-	-	-	-
39110.	770.	-	-	-	-	-	ND	-	-	-	-	-
39110.	1060.	-	-	-	-	-	ND	-	-	-	-	-
39110.	1160.	-	-	-	-	-	ND	-	-	-	-	-
39110.	300.	-	-	-	-	-	ND	50.	4.	-	-	-
39110.	320.	1000.	75.	-	-	-	ND	50.	8.	-	-	-
39110.	90.	-	-	88.	0.024	1.	ND	-	-	-	-	-
39110.	120.	1000.	30.	-	-	-	ND	50.	4.	-	-	-
39110.	390.	-	-	265.	0.547	1.	ND	-	-	-	-	-
39110.	450.	-	-	-	-	-	5.	50.	0.	-	-	-
39110.	46.	1000.	-2.	-	-	-	5.	-	-	2.	1.138	1.
39110.	230.	1000.	177.	-	-	-	ND	50.	4.	-	-	-
39110.	1600.	1000.	-119.	-	-	-	ND	50.	4.	-	-	-
39110.	10.	-	-	10.	0.000	1.	1.	-	-	2.	1.139	1.
39110.	60.	1000.	40.	-	-	-	5.	50.	34.	-	-	-
39110.	36.	1000.	21.	-	-	-	5.	50.	20.	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
39110.	ND	1000.	40.	-	-	-	5.	50.	0.	-	-	-
39110.	24.	-	-	24.	0.000	1.	5.	-	-	5.	0.000	1.
39110.	140.	1000.	48.	-	-	-	5.	50.	22.	-	-	-
39110.	11.	-	-	13.	0.219	1.	5.	-	-	5.	0.000	1.
39110.	5.	1000.	54.	-	-	-	5.	50.	26.	-	-	-
39110.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	1.
34566./34571.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34536.	11.	10.	160.	-	-	-	ND	-	-	-	-	-
34536.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34536.	5.	8.	0.	-	-	-	ND	-	-	-	-	-
34536.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34536.	470.	470.	6.	-	-	-	ND	-	-	-	-	-
34536.	430.	450.	139.	-	-	-	ND	-	-	-	-	-
34536.	634.	-	-	569.	0.154	1.	ND	-	-	-	-	-
34536.	1200.	1200.	-17.	-	-	-	ND	-	-	-	-	-
34536.	350.	-	-	422.	0.236	1.	ND	-	-	-	-	-
34536.	350.	450.	53.	-	-	-	ND	-	-	-	-	-
34536.	480.		-	509.	0.083	1.	ND	-	-	-	-	-
34536.	460.	-	-	470.	0.030	1.	65.	12.	58.	55.	0.013	1.
34536.	960.	-	-	960.	0.000	1.	ND	13.	58.	-	-	-
34536.	440.	-	-	460.	0.033	1.	16.	12.	108.	17.	0.083	1.
34536.	380.	-	-	383.	0.129	1.	18.	12.	117.	16.	0.088	1.
34536.	330.	-	-	304.	0.116	1.	63.	11.	318.	66.	0.074	1.
34536.	400.	-	-	379.	0.074	1.	11.	-	-	12.	0.178	3.
34536.	380.	-	-	390.	0.036	1.	16.	-	-	17.	0.173	3.
34536.	404.	625.	148.	-	-	-	20.	125.	130.	-	-	-
34536.	702.	1130.	91.	-	-	-	15.	125.	191.	-	-	-
34536.	462.	-	-	478.	0.047	1.	13.	-	-	2.	2.660	1.
34536.	380.	600.	132.	-	-	-	5.	125.	82.	-	-	-
34536.	538.	-	-	497.	0.112	1.	5.	-	-	13.	1.334	1.
34536.	686.	750.	46.	-	-	-	ND	125.	105.	-	-	-
34536.	1220.	1250.	59.	-	-	-	ND	125.	118.	-	-	-
34536.	881.	938.	86.	-	-	-	ND	125.	110.	-	-	-
34536.	910.	-	-	973.	0.094	1.	ND	-	-	-	-	-
34536.	517.	563.	100.	-	-	-	ND	125.	120.	-	-	-
34536.	338.	-	-	319.	0.082	1.	ND	-	-	-	-	-
34536.	381.	375.	298.	-	-	-	143.	125.	318.	-	-	-
34536.	511.	-	-	530.	0.052	1.	ND	-	-	-	-	-
34536.	505.	625.	50.	-	-	-	ND	250.	88.	-	-	-
34536.	878.	-	-	864.	0.023	1.	ND	-	-	-	-	-
34536.	304.	375.	66.	-	-	-	ND	125.	136.	-	-	-
34536.	387.	-	-	385.	0.007	1.	ND	-	-	-	-	-
34536.	508.	625.	124.	-	-	-	ND	188.	91.	-	-	-
34536.	ND	-	-	-	-	-	41.	250.	71.	-	-	-
34536.	402.	-	-	407.	0.019	1.	ND	-	-	-	-	-
34536.	430.	563.	78.	-	-	-	ND	125.	66.	-	-	-
34536.	ND	-	-	-	-	-	39.	-	-	6.	2.691	1.
34536.	657.	875.	46.	-	-	-	117.	250.	28.	-	-	-
34536.	565.	625.	46.	-	-	-	36.	150.	65.	-	-	-
34536.	541.	-	-	587.	0.115	1.	ND	-	-	-	-	-
34536.	164.	375.	83.	-	-	-	ND	188.	73.	-	-	-
34536.	481.	-	-	458.	0.069	1.	ND	-	-	-	-	-
34536.	ND	-	-	-	-	-	232.	-	-	242.	0.061	1.
34536.	ND	-	-	-	-	-	ND	125.	136.	-	-	-
34536.	ND	-	-	-	-	-	ND	250.	66.	-	-	-
34336.	ND	-	-	-	-	-	5.	-	-	-	-	-
34336.	5.	-	-	-	-	-	ND	-	-	-	-	-
34336.	1.	-	-	2.	1.139	1.	ND	-	-	-	-	-
34336.	2600.	2500.	120.	-	-	-	5.	5.	500.	-	-	-
34336.	48.	500.	138.	-	-	-	ND	-	-	-	-	-
34336.	380.	-	-	399.	0.071	1.	5.	-	-	5.	0.000	1.
34336.	220.	200.	85.	-	-	-	52.	50.	-4.	-	-	-
34336.	1600.	-	-	1876.	0.226	1.	15.	-	-	16.	0.046	1.
34336.	1800.	1800.	17.	-	-	-	22.	20.	20.	-	-	-
34336.	360.	-	-	350.	0.040	1.	14.	-	-	12.	0.170	1.
34336.	1740.	1020.	46.	-	-	-	ND	-	-	-	-	-
34336.	500.	500.	91.	-	-	-	ND	-	-	-	-	-
34336.	410.	-	-	405.	0.017	1.	ND	-	-	-	-	-
34336.	141.	500.	79.	-	-	-	ND	-	-	-	-	-
34336.	1420.	-	-	1799.	0.335	1.	ND	-	-	-	-	-
34336.	2400.	2010.	40.	-	-	-	ND	-	-	-	-	-
34336.	1420.	-	-	1450.	0.029	1.	ND	-	-	-	-	-
34336.	65.	-	-	-	-	-	ND	-	-	-	-	-
34336.	120.	-	-	-	-	-	ND	-	-	-	-	-
34336.	64.	-	-	-	-	-	ND	-	-	-	-	-
34336.	162.	-	-	-	-	-	ND	-	-	-	-	-
34336.	110.	-	-	-	-	-	ND	-	-	-	-	-
34336.	96.	-	-	-	-	-	5.	50.	0.	-	-	-
34336.	28.	1000.	8.	-	[illegible]	-	ND	50.	18.	-	-	-
34336.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34336.	18.	4000.	20.	-	-	-	ND	50.	4.	-	-	-
34336.	16.	-	-	-	-	-	5.	50.	0.	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34336.	30.	1000.	-3.	-	-	-	5.	-	-	5.	0.000	1.
34336.	5.	1000.	63.	-	-	-	5.	50.	0.	-	-	-
34336.	230.	1000.	-17.	-	-	-	5.	50.	0.	-	-	-
34336.	10.	-	-	10.	0.000	1.	ND	-	-	-	-	-
34336.	560.	1000.	33.	-	-	-	5.	50.	16.	-	-	-
34336.	280.	1000.	25.	-	-	-	ND	50.	14.	-	-	-
34336.	ND	1000.	44.	-	-	-	12.	50.	-14.	-	-	-
34336.	860.	-	-	865.	0.008	1.	20.	-	-	20.	0.000	1.
34336.	370.	1000.	12.	-	-	-	12.	50.	16.	-	-	-
34336.	120.	-	-	80.	0.578	1.	11.	-	-	14.	0.308	1.
34336.	13.	1000.	26.	-	-	-	16.	50.	-4.	-	-	-
34336.	5.	-	-	5.	0.000	1.	11.	-	-	7.	0.557	1.
34341.	40.	-	-	46.	0.212	1.	ND	-	-	-	-	-
34341.	5.	-	-	-	-	-	ND	-	-	-	-	-
34341.	1.	-	-	2.	1.139	1.	ND	-	-	-	-	-
34341.	650.	600.	75.	-	-	-	ND	-	-	-	-	-
34341.	57.	60.	238.	-	-	-	ND	-	-	-	-	-
34341.	74.	-	-	35.	1.040	1.	ND	-	-	-	-	-
34341.	11.	10.	1890.	-	-	-	ND	-	-	-	-	-
34341.	5.	-	-	34.	2.707	1.	ND	-	-	-	-	-
34341.	400.	400.	70.	-	-	-	ND	-	-	-	-	-
34341.	210.	-	-	171.	0.287	1.	ND	-	-	-	-	-
34341.	600.	320.	112.	-	-	-	ND	-	-	-	-	-
34341.	1470.	-	-	1339.	0.132	1.	ND	-	-	-	-	-
34341.	104.	-	-	101.	0.035	1.	ND	-	-	-	-	-
34341.	619.	640.	130.	-	-	-	ND	-	-	-	-	-
34341.	709.	-	-	759.	0.096	1.	ND	-	-	-	-	-
34341.	5.	-	-	-	-	-	5.	-	-	-	-	-
34341.	5.	-	-	-	-	-	ND	-	-	-	-	-
34341.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	1.
34341.	18.	1000.	-1.	-	-	-	5.	-	-	-	-	-
34341.	5.	-	-	5.	0.000	1.	5.	-	-	2.	1.138	1.
34341.	12.	-	-	-	-	-	ND	-	-	-	-	-
34341.	5.	1000.	0.	-	-	-	5.	-	-	5.	0.000	1.
34341.	26.	1000.	3.	-	-	-	ND	-	-	-	-	-
34341.	470.	1000.	-41.	-	-	-	ND	-	-	-	-	-
34341.	5.	-	-	8.	0.619	1.	5.	-	-	2.	1.138	1.
34341.	220.	-	-	-	-	-	ND	-	-	-	-	-
34341.	120.	-	-	-	-	-	ND	-	-	-	-	-
34341.	340.	-	-	325.	0.065	1.	5.	-	-	2.	1.138	1.
34341.	410.	1000.	-16.	-	-	-	ND	-	-	-	-	-
34341.	13.	-	-	16.	0.268	1.	5.	-	-	5.	0.000	1.
34341.	12.	1000.	1.	-	-	-	ND	-	-	-	-	-
34341.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34341.	ND	-	-	-	-	-	ND	1.	0.	-	-	-
34341.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34341.	ND	-	-	-	-	-	ND	50.	2.	-	-	-
34596.	73.	70.	7.	-	-	-	5.	2.	0.	-	-	-
34596.	94.	-	-	72.	0.379	1.	5.	-	-	5.	0.000	1.
34596.	17.	18.	-33.	-	-	-	5.	2.	0.	-	-	-
34596.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34596.	17.	-	-	15.	0.190	1.	ND	-	-	-	-	-
34596.	52.	-	-	53.	0.027	1.	ND	-	-	-	-	-
34376.	220.	220.	41.	-	-	-	23.	20.	55.	-	-	-
34376.	63.	60.	95.	-	-	-	5.	-	-	5.	0.000	1.
34376.	40.	-	-	46.	0.186	1.	1.	-	-	2.	1.139	1.
34376.	110.	110.	36.	-	-	-	5.	-	-	5.	0.000	1.
34376.	250.	-	-	260.	0.054	1.	5.	-	-	5.	0.000	1.
34376.	370.	190.	111.	-	-	-	5.	-	-	5.	0.000	1.
34376.	220.	-	-	235.	0.090	1.	5.	-	-	5.	0.000	1.
34376.	64.	-	-	-	-	-	ND	-	-	-	-	-
34376.	78.	-	-	-	-	-	ND	-	-	-	-	-
34376.	54.	-	-	-	-	-	ND	-	-	-	-	-
34376.	5.	-	-	-	-	-	ND	-	-	-	-	-
34376.	5.	-	-	-	-	-	ND	-	-	-	-	-
34376.	5.	100.	31.	-	-	-	ND	-	-	-	-	-
34376.	5.	-	-	-	-	-	ND	-	-	-	-	-
34376.	ND	-	-	-	-	-	1.	-	-	2.	1.139	1.
34376.	5.	-	-	-	-	-	ND	-	-	-	-	-
34376.	5.	-	-	-	-	-	ND	-	-	-	-	-
34376.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
34376.	5.	100.	23.	-	-	-	ND	-	-	-	-	-
34376.	5.	-	-	-	-	-	ND	-	-	-	-	-
34376.	5.	100.	0.	-	-	-	ND	-	-	-	-	-
34376.	ND	10.	0.	-	-	-	ND	-	-	-	-	-
34381.	200.	200.	60.	-	-	-	5.	-	-	-	-	-
34381.	81.	80.	74.	-	-	-	ND	-	-	-	-	-
34381.	44.	-	-	45.	0.031	1.	ND	-	-	-	-	-
34381.	130.	130.	100.	-	-	-	ND	-	-	-	-	-
34381.	300.	-	-	279.	0.101	1.	ND	-	-	-	-	-
34381.	260.	130.	185.	-	-	-	ND	-	-	-	-	-
34381.	150.	-	-	155.	0.046	1.	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34381.	87.	-	-	-	-	-	ND	-	-	-	-	-
34381.	110.	-	-	-	-	-	ND	-	-	-	-	-
34381.	62.	-	-	-	-	-	ND	-	-	-	-	-
34408.	650.	-	-	650.	0.000	1.	ND	-	-	-	-	-
39250.	9700.	620.	-258.	-	-	-	14.	20.	85.	-	-	-
39250.	760.	780.	172.	-	-	-	5.	-	-	5.	0.000	1.
39250.	1200.	-	-	1342.	0.158	1.	5.	-	-	2.	1.138	1.
39250.	1300.	1300.	415.	-	-	-	1.	-	-	2.	1.139	1.
39250.	6700.	-	-	7136.	0.089	1.	5.	-	-	2.	1.138	1.
39250.	5200.	2600.	223.	-	-	-	1.	-	-	2.	1.139	1.
39250.	6000.	-	-	6245.	0.057	1.	5.	-	-	5.	0.000	1.
39250.	3900.	-	-	-	-	-	ND	54.	53.	-	-	-
39250.	4250.	-	-	-	-	-	ND	-	-	-	-	-
39250.	966.	-	-	-	-	-	ND	-	-	-	-	-
39250.	5.	7.	71.	-	-	-	ND	-	-	-	-	-
34447.	12900.	12000.	43.	-	-	-	ND	150.	101.	-	-	-
34447.	13600.	-	-	14659.	0.106	1.	ND	-	-	-	-	-
34447.	8750.	12500.	77.	-	-	-	ND	200.	98.	-	-	-
34447.	9550.	-	-	7897.	0.269	1.	ND	-	-	-	-	-
34447.	10700.	12500.	69.	-	-	-	ND	250.	94.	-	-	-
34447.	9190.	12500.	85.	-	-	-	ND	300.	76.	-	-	-
34447.	12500.	-	-	12400.	0.011	1.	ND	-	-	-	-	-
34447.	11100.	25000.	62.	-	-	-	ND	500.	107.	-	-	-
34447.	3960.	-	-	5046.	0.343	1.	ND	-	-	-	-	-
34447.	3840.	10399.	51.	-	-	-	ND	100.	63.	-	-	-
34447.	5050.	-	-	4438.	0.183	1.	ND	-	-	-	-	-
34447.	1983.	3750.	55.	-	-	-	ND	200.	101.	-	-	-
34447.	2900.	3750.	85.	-	-	-	ND	50.	101.	-	-	-
34447.	6390.	-	-	6380.	0.002	1.	ND	-	-	-	-	-
34447.	2660.	5000.	98.	-	-	-	ND	125.	97.	-	-	-
34447.	2080.	6240.	109.	-	-	-	ND	188.	64.	-	-	-
34447.	3530.	-	-	3594.	0.026	1.	ND	-	-	-	-	-
34447.	5360.	-	-	5019.	0.093	1.	ND	-	-	-	-	-
34447.	5090.	12500.	104.	-	-	-	ND	125.	86.	-	-	-
34447.	5610.	-	-	4951.	0.177	1.	ND	-	-	-	-	-
34447.	4370.	9371.	56.	-	-	-	ND	188.	75.	-	-	-
34447.	6400.	12500.	103.	-	-	-	ND	156.	97.	-	-	-
34447.	5410.	-	-	4999.	0.112	1.	ND	-	-	-	-	-
34447.	4070.	9370.	118.	-	-	-	ND	125.	66.	-	-	-
34447.	4760.	9370.	115.	-	-	-	ND	125.	82.	-	-	-
34447.	3420.	-	-	3375.	0.019	1.	ND	-	-	-	-	-
34447.	5950.	12500.	88.	-	-	-	ND	94.	91.	-	-	-
34447.	4370.	9370.	54.	-	-	-	ND	188.	78.	-	-	-
34447.	6180.	-	-	5113.	0.268	1.	ND	-	-	-	-	-
34447.	ND	-	-	-	-	-	ND	100.	133.	-	-	-
34447.	20.	-	-	-	-	-	ND	-	-	-	-	-
34447.	5.	100.	87.	-	-	-	ND	50.	80.	-	-	-
34447.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34447.	ND	-	-	-	-	-	320.	-	-	314.	0.027	1.
34447.	ND	-	-	-	-	-	ND	20.	0.	-	-	-
34447.	ND	-	-	-	-	-	ND	50.	38.	-	-	-
34447.	ND	100.	24.	-	-	-	ND	50.	34.	-	-	-
34447.	ND	100.	70.	-	-	-	ND	50.	44.	-	-	-
34447.	ND	-	-	-	-	-	ND	50.	22.	-	-	-
34447.	ND	100.	66.	-	-	-	28.	50.	-20.	-	-	-
34447.	ND	100.	76.	-	-	-	ND	50.	14.	-	-	-
34447.	ND	100.	50.	-	-	-	ND	50.	12.	-	-	-
34447.	ND	100.	55.	-	-	-	ND	100.	55.	-	-	-
34447.	ND	100.	65.	-	-	-	ND	50.	42.	-	-	-
34447.	ND	100.	49.	-	-	-	ND	50.	38.	-	-	-
34469.	220.	220.	45.	-	-	-	24.	20.	55.	-	-	-
34469.	65.	60.	92.	-	-	-	5.	-	-	5.	0.000	1.
34469.	54.	-	-	48.	0.178	1.	1.	-	-	2.	1.139	1.
34469.	120.	120.	33.	-	-	-	5.	-	-	5.	0.000	1.
34469.	260.	-	-	270.	0.052	1.	5.	-	-	5.	0.000	1.
34469.	400.	200.	100.	-	-	-	5.	-	-	5.	0.000	1.
34469.	230.	-	-	249.	0.113	1.	5.	-	-	5.	0.000	1.
34469.	46.	-	-	-	-	-	ND	-	-	-	-	-
34469.	56.	-	-	-	-	-	ND	-	-	-	-	-
34469.	40.	-	-	-	-	-	ND	-	-	-	-	-
34469.	5.	6.	150.	-	-	-	ND	-	-	-	-	-
34469.	5.	1.	0.	-	-	-	ND	-	-	-	-	-
34469.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34469.	5.	-	-	-	-	-	ND	-	-	-	-	-
34469.	5.	100.	19.	-	-	-	ND	-	-	-	-	-
34469.	5.	-	-	-	-	-	ND	-	-	-	-	-
34469.	5.	-	-	-	-	-	ND	-	-	-	-	-
34469.	ND	-	-	-	-	-	5.	-	-	2.	1.138	1.
34469.	5.	-	-	-	-	-	5.	-	-	-	-	-
34469.	5.	-	-	-	-	-	5.	-	-	-	-	-
34469.	ND	-	-	-	-	-	5.	-	-	-	-	-
34469.	ND	4.	0.	-	-	-	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34469.	ND	100.	1.	-	-	-	ND	-	-	-	-	-
34551.	130.	130.	62.	-	-	-	25.	25.-	296.	-	-	-
34551.	38.	40.	40.	-	-	-	33.	30.	100.	-	-	-
34551.	410.	-	-	415.	0.017	1.	24.	-	-	24.	0.029	1.
34551.	50.	50.	140.	-	-	-	5.	10.	250.	-	-	-
34551.	59.	-	-	56.	0.063	1.	26.	-	-	24.	0.087	1.
34551.	150.	150.	-7.	-	-	-	20.	20.	60.	-	-	-
34551.	36.	-	-	36.	0.000	1.	13.	-	-	9.	0.676	1.
34551.	160.	170.	12.	-	-	-	21.	25.	88.	-	-	-
34551.	110.	110.	173.	-	-	-	15.	15.	60.	-	-	-
34551.	400.	-	-	429.	0.099	1.	78.	-	-	81.	0.052	1.
34551.	460.	480.	44.	-	-	-	40.	40.	115.	-	-	-
34551.	210.	-	-	171.	0.287	1.	85.	-	-	83.	0.025	1.
34551.	110.	120.	175.	-	-	-	30.	30.	93.	-	-	-
34551.	240.	-	-	245.	0.029	1.	39.	-	-	37.	0.077	1.
34551.	210.	-	-	220.	0.064	1.	59.	56.	145.	59.	. 0.012	1.
34551.	550.	-	-	524.	0.067	1.	18.	58.	98.	18.	0.000	1.
34551.	130.	-	-	113.	0.200	1.	32.	57.	102.	29.	0.120	1.
34551.	330.	-	-	287.	0.196	1.	72.	56.	140.	69.	0.051	1.
34551.	110.	-	-	104.	0.075	1.	65.	46.	76.	63.	0.045	1.
34551.	120.	-	-	120.	0.000	1.	100.	-	-	75.	0.201	3.
34551.	260.	-	-	265.	0.027	1.	37.	-	-	43.	0.215	3.
34551.	103.	188.	103.	-	-	-	ND	250.	85.	-	-	-
34551.	250.	313.	142.	-	-	-	ND	250.	86.	-	-	-
34551.	144.	-	-	209.	0.526	1.	ND	-	-	-	-	-
34551.	100.	125.	104.	-	-	-	ND	250.	72.	-	-	-
34551.	97.	-	-	112.	0.208	1.	ND	-	-	-	-	-
34551.	227.	250.	162.	-	-	-	ND	250.	40.	-	-	-
34551.	290.	312.	83.	-	-	-	ND	250.	110.	-	-	-
34551.	360.	375.	70.	-	-	-	16.	250.	76.	-	-	-
34551.	184.	-	-	146.	0.326	1.	14.	-	-	15.	0.103	1.
34551.	153.	125.	65.	-	-	-	25.	250.	77.	-	-	-
34551.	68.	-	-	50.	0.448	1.	20.	-	-	21.	0.090	1.
34551.	52.	156.	337.	-	-	-	14.	125.	127.	-	-	-
34551.	ND	-	-	-	-	-	101.	250.	178.	-	-	-
34551.	616.	-	-	660.	0.098	1.	45.	-	-	47.	0.066	1.
34551.	967.	1250.	-6.	-	-	-	31.	375.	90.	-	-	-
34551.	1044.	-	-	1119.	0.098	1.	18.	-	-	4.	2.044	1.
34551.	880.	1125.	24.	-	-	-	ND	375.	88.	-	-	-
34551.	1261.	-	-	1267.	0.007	1.	15.	-	-	13.	0.152	1.
34551.	1490.	1875.	90.	-	-	-	390.	500.	47.	-	-	-
34551.	1430.	1250.	150.	-	-	-	342.	500.	104.	-	-	-
34551.	546.	-	-	527.	0.061	1.	772.	-	-	1118.	0.524	1.
34551.	742.	938.	87.	-	-	-	18.	250.	57.	-	-	-
34551.	1180.	1250.	35.	-	-	-	18.	250.	122.	-	-	-
34551.	60.	375.	116.	-	-	-	91.	250.	63.	-	-	-
34551.	ND	-	-	-	-	-	18.	250.	85.	-	-	-
34551.	660.	-	-	673.	0.028	1.	547.	-	-	576.	0.074	1.
34551.	433.	-	-	403.	0.102	1.	ND	-	-	-	-	-

ACID TOXIC ORGANIC

POLLUTANTS

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34453.	ND	[illegible]	127.	-	-	-	5.	8.	250.	-	-	-
34453.	ND	-	-	-	-	-	13.	-	-	13.	0.053	1.
34453.	ND	-	-	-	-	-	ND	40.	93.	-	-	-
34586.	5.	-	-	-	-	-	ND	-	-	-	-	-
34586.	5.	2.	0.	-	-	-	ND	-	-	-	-	-
34586.	5.	-	-	-	-	-	ND	-	-	-	-	-
34586.	32.	32.	159.	-	-	-	ND	-	-	-	-	-
34586.	22.	20.	100.	-	-	-	ND	-	-	-	-	-
34586.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34586.	5.	3.	0.	-	-	-	5.	1.	0.	-	-	-
34586.	11.	10.	60.	-	-	-	ND	-	-	-	-	-
34586.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34586.	16.	-	-	-	-	-	ND	-	-	-	-	-
34586.	18.	-	-	-	-	-	ND	50.	48.	-	-	-
34586.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34586.	18.	100.	152.	-	-	-	ND	50.	36.	-	-	-
34586.	5.	100.	24.	-	-	-	ND	50.	22.	-	-	-
34586.	14.	-	-	8.	0.727	1.	ND	-	-	-	-	-
34586.	ND	-	-	-	-	-	1.	-	-	3.	1.696	1.
34586.	ND	-	-	-	-	-	ND	50.	16.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	32.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	26.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	44.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	58.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	28.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	48.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	34.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	170.	-	-	-
34586.	ND	-	-	-	-	-	ND	50.	40.	-	-	-
34586.	140.	140.	-14.	-	-	-	ND	-	-	-	-	-
34586.	76.	80.	80.	-	-	-	ND	-	-	-	-	-
34586.	50.	-	-	47.	0.090	1.	ND	-	-	-	-	-
34586.	56.	62.	135.	-	-	-	ND	-	-	-	-	-
34586.	74.	-	-	68.	0.125	1.	ND	-	-	-	-	-
34586.	65.	60.	158.	-	-	-	ND	-	-	-	-	-
34586.	78.	-	-	80.	0.035	1.	ND	-	-	-	-	-
34586.	110.	-	-	105.	0.067	1.	ND	-	-	-	-	-
34586.	140.	-	-	130.	0.109	1.	ND	-	-	-	-	-
34586.	99.	-	-	88.	0.169	1.	ND	12.	117.	-	-	-
34586.	90.	-	-	87.	0.049	1.	ND	12.	108.	-	-	-
34586.	59.	-	-	38.	0.636	1.	ND	11.	118.	-	-	-
34586.	87.	-	-	80.	0.124	1.	ND	-	-	-	-	-
34586.	84.	-	-	76.	0.149	1.	5.	-	-	9.	0.409	3.
34586.	381.	625.	108.	-	-	-	66.	374.	41.	-	-	-
34586.	255.	375.	87.	-	-	-	40.	250.	52.	-	-	-
34586.	141.	-	-	131.	0.108	1.	35.	-	-	48.	0.444	1.
34586.	152.	250.	143.	-	-	-	35.	125.	65.	-	-	-
34586.	145.	-	-	181.	0.311	1.	68.	-	-	61.	0.145	1.
34586.	119.	125.	3.	-	-	-	59.	125.	50.	-	-	-
34586.	142.	156.	76.	-	-	-	20.	125.	60.	-	-	-
34586.	99.	125.	114.	-	-	-	5.	125.	44.	-	-	-
34586.	141.	-	-	120.	0.229	1.	1.	-	-	2.	1.139	1.
34586.	91.	125.	137.	-	-	-	16.	125.	40.	-	-	-
34586.	134.	-	-	131.	0.146	1.	5.	-	-	5.	0.000	1.
34586.	31.	94.	104.	-	-	-	43.	188.	110.	-	-	-
34586.	98.	-	-	97.	0.014	1.	33.	-	-	29.	0.191	1.
34586.	100.	125.	193.	-	-	-	ND	250.	94.	-	-	-
34586.	114.	-	-	109.	0.058	1.	52.	-	-	57.	0.133	1.
34586.	124.	188.	137.	-	-	-	124.	250.	45.	-	-	-
34586.	76.	-	-	85.	0.159	1.	77.	-	-	71.	0.113	1.
34586.	62.	125.	164.	-	-	-	ND	250.	101.	-	-	-
34586.	95.	250.	93.	-	-	-	ND	250.	68.	-	-	-
34586.	80.	-	-	81.	0.023	1.	ND	-	-	-	-	-
34586.	81.	250.	90.	-	-	-	99.	625.	87.	-	-	-
34586.	76.	-	-	83.	0.132	1.	ND	-	-	-	-	-
34586.	105.	250.	102.	-	-	-	17.	250.	85.	-	-	-
34586.	70.	438.	106.	-	-	-	ND	250.	79.	-	-	-
34586.	78.	188.	67.	-	-	-	81.	150.	26.	-	-	-
34586.	160.	-	-	198.	0.304	1.	108.	-	-	114.	0.080	1.
34586.	184.	250.	49.	-	-	-	80.	250.	62.	-	-	-
34586.	93.	-	-	113.	0.276	1.	ND	-	-	-	-	-
34586.	ND	-	-	-	-	-	144.	-	-	154.	0.092	1.
34586.	ND	-	-	-	-	-	ND	62.	163.	-	-	-
34601.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
34601.	5.	2.	0.	-	-	-	ND	-	-	-	-	-
34601.	420.	320.	0.	-	-	-	13.	10.	-130.	-	-	-
34601.	400.	400.	200.	-	-	-	ND	10.	0.	-	-	-
34601.	420.	-	-	376.	0.149	1.	ND	-	-	-	-	-
34601.	490.	490.	71.	-	-	-	ND	-	-	-	-	-
34601.	400.	-	-	352.	0.180	1.	10.	-	-	3.	1.628	1.
34601.	350.	350.	106.	-	-	-	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34601.	480.	-	-	480.	0.000	1.	16.	-	-	15.	0.094	1.
34601.	640.	-	-	665.	0.053	1.	ND	57.	77.	-	-	-
34601.	890.	-	-	875.	0.024	1.	ND	59.	102.	-	-	-
34601.	620.	-	-	610.	0.023	1.	ND	61.	93.	-	-	-
34601.	780.	-	-	785.	0.009	1.	ND	59.	114.	-	-	-
34601.	640.	-	-	635.	0.011	1.	ND	54.	104.	-	-	-
34601.	500.	-	-	495.	0.014	1.	ND	-	-	-	-	-
34601.	840.	-	-	830.	0.017	1.	200.	-	-	216.	0.125	3.
34601.	493.	625.	104.	-	-	-	14.	157.	57.	-	-	-
34601.	314.	375.	115.	-	-	-	19.	250.	60.	-	-	-
34601.	361.	-	-	380.	0.074	1.	5.	-	-	9.	0.870	1.
34601.	237.	311.	118.	-	-	-	11.	112.	67.	-	-	-
34601.	430.	-	-	393.	0.128	1.	17.	-	-	9.	0.850	1.
34601.	467.	500.	85.	-	-	-	17.	175.	59.	-	-	-
34601.	366.	375.	82.	-	-	-	16.	156.	80.	-	-	-
34601.	280.	312.	107.	-	-	-	6.	94.	68.	-	-	-
34601.	334.	-	-	328.	0.026	1.	5.	-	-	8.	0.687	1.
34601.	282.	312.	78.	-	-	-	25.	250.	78.	-	-	-
34601.	276.	-	-	228.	0.268	1.	17.	-	-	22.	0.337	1.
34601.	160.	156.	117.		-	-	25.	250.	111.	-	-	-
34601.	ND	-	-	-	-	-	10.	106.	106.		-	-
34601.	284.	-	-	285.	0.002	1.	31.	-	-	31.	0.013	1.
34601.	276.	312.	84.	-	-	-	32.	375.	52.	-	-	-
34601.	428.	-	-	423.	0.017	1.	32.	-	-	34.	0.079	1.
34601.	284.	375.	75.	-	-	-	31.	188.	66.	-	-	-
34601.	303.	-	-	306.	0.014	1.	23.	-	-	23.	0.000	1.
34601.	393.	312.	142.	-	-	-	31.	188.	102.	-	-	-
34601.	283.	375.	127.	-	-	-	27.	375.	100.	-	-	-
34601.	245.	-	-	261.	0.092	1.	40.	-	-	37.	0.113	1.
34601.	341.	438.	85.	-	-	-	ND	125.	105.	-	-	-
34601.	273.	-	-	302.	0.145	1.	ND	-	-	-	-	-
34601.	282.	875.	130.	-	-	-	12.	375.	201.	-	-	-
34601.	726.	500.	149.	-	-	-	46.	500.	125.	-	-	-
34601.	482.	375.	111.	-	-	-	17.	188.	20.	-	-	-
34601.	384.	-	-	383.	0.004	1.	82.	-	-	78.	0.076	1.
34601.	381.	500.	82.	-	-	-	291.	375.	63.	-	-	-
34601.	228.	-	-	229.	0.003	1.	170.	-	-	174.	0.033	1.
34601.	ND	-	-	-	-	-	222.	-	-	229.	0.043	1.
34606.	800.	800.	38.	-	-	-	5.	-	-	5.	0.000	1.
34606.	1400.	1400.	-21.	-	-	-	ND	-	-	-	-	-
34606.	900.	-	-	849.	0.083	1.	ND	-	-	-	-	-
34606.	3200.	-	-	2040.	0.637	1.	5.	-	-	5.	0.000	1.
34606.	2600.	-	-	2223.	0.222	1.	5.	-	-	5.	0.000	1.
34606.	1800.	700.	14.	-	-	-	5.	-	-	5.	0.000	1.
34606.	1400.	-	-	1700.	0.438	1.	5.	-	-	5.	0.000	1.
34606.	384.	-	-	-	-	-	ND	-	-	-	-	-
34606.	2400.	-	-	-	-	-	ND	-	-	-	-	-
34606.	676.	-	-	-	-	-	ND	-	-	-	-	-
34606.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
34606.	5.	5.	0.	-	-	-	5.	6.	0.	-	-	-
34606.	5.	-	-	5.	0.000	1.	5.	-	-	5.	0.000	1.
34616.	2100.	2000.	195.	-	-	-	1.	-	-	2.	1.139	1.
34616.	2300.	2700.	396.	-	-	-	ND	-	-	-	-	-
34616.	84.	-	-	119.	0.498	1.	ND	-	-	-	-	-
34616.	3900.	4000.	203.	-	-	-	ND	-	-	-	-	-
34616.	1500.	-	-	1549.	0.046	1.	260.	-	-	16.	3.932	1.
34616.	3000.	3000.	83.	-	-	-	ND	-	-	-	-	-
34616.	2800.	-	-	2800.	0.000	1.	ND	-	-	-	-	-
34616.	1070.	1000.	86.	-	-	-	ND	-	-	-	-	-
34616.	759.	-	-	840.	0.153	1.	ND	-	-	-	-	-
34616.	837.	1000.	110.	-	-	-	ND	150.	93.	-	-	-
34616.	1364.	-	-	1230.	0.146	1.	ND	-	-	-	-	-
34616.	1270.	1500.	35.	-	-	-	ND	-	-	-	-	-
34616.	1230.	2000.	43.	-	-	-	ND	200.	81.	-	-	-
34616.	898.	-	-	835.	0.103	1.	ND	-	-	-	-	-
34616.	340.	200.	291.	-	-	-	ND	-	-	-	-	-
34616.	640.	-	-	582.	0.133	1.	ND	-	-	-	-	-
34616.	165.	400.	91.	-	-	-	ND	750.	57.	-	-	-
34616.	250.	-	-	181.	0.457	1.	ND	-	-	-	-	-
34616.	377.	800.	31.	-	-	-	ND	150.	108.	-	-	-
34616.	1185.	2000.	122.	-	-	-	ND	-	-	-	-	-
34616.	1286.	-	-	1090.	0.232	1.	ND	-	-	-	-	-
34616.	919.	2000.	93.	-	-	-	ND	300.	60.	-	-	-
34616.	684.	1400.	79.	-	-	-	ND	-	-	-	-	-
34616.	694.	-	-	648.	0.097	1.	ND	-	-	-	-	-
34616.	1173.	-	-	1203.	0.035	1.	ND	-	-	-	-	-
34616.	1024.	2000.	22.	-	-	-	ND	200.	79.	-	-	-
34616.	1247.	-	-	1209.	0.044	1.	ND	-	-	-	-	-
34616.	1225.	3001.	16.	-	-	-	ND	-	-	-	-	-
34616.	1092.	2000.	46.	-	-	-	ND	150.	70.	-	-	-
34616.	1581.	-	-	1280.	0.299	1.	ND	-	-	-	-	-
34616.	1561.	3000.	26.	-	-	-	ND	200.	63.	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34616.	1199.	2000.	47.	-	-	-	ND	250.	68.	-	-	-
34616.	907.	-	-	933.	0.039	1.	ND	-	-	-	-	-
34616.	748.	1500.	18.	-	-	-	ND	200.	97.	-	-	-
34616.	923.	2000.	33.	-	-	-	ND	300.	54.	-	-	-
34616.	723.	-	-	728.	0.011	1.	ND	-	-	-	-	-
34616.	ND	-	-	-	-	-	ND	100.	142.	-	-	-
34616.	990.	1000.	221.	-	-	-	ND	-	-	-	-	-
34616.	ND	-	-	-	-	-	15.	-	-	15.	0.000	1.
34616.	ND	-	-	-	-	-	12.	100.	114.	-	-	-
34616.	928.	1000.	138.	-	-	-	114.	100.	220.	-	-	-
34616.	215.	-	-	187.	0.196	1.	505.	-	-	464.	0.120	1.
34616.	291.	200.	82.	-	-	-	15.	-	-	-	-	-
34616.	5.	-	-	-	-	-	ND	-	-	-	-	-
34616.	35.	-	-	-	-	-	ND	-	-	-	-	-
34616.	320.	-	-	-	-	-	ND	-	-	-	-	-
34616.	53.	-	-	7.	2.807	1.	ND	-	-	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34616.	ND	-	-	-	-	-	ND	50.	0.	-	-	-
34657.	ND	-	-	-	-	-	ND	100.	65.	-	-	-
34657.	ND	-	-	-	-	-	ND	150.	83.	-	-	-
34657.	ND	-	-	-	-	-	ND	200.	42.	-	-	-
34657.	ND	-	-	-	-	-	ND	80.	106.	-	-	-
34657.	ND	-	-	-	-	-	ND	100.	75.	-	-	-
34657.	ND	-	-	-	-	-	ND	100.	82.	-	-	-
34591.	36.	36.	83.	-	-	-	ND	-	-	-	-	-
34591.	35.	35.	243.	-	-	-	ND	-	-	-	-	-
34591.	12.	-	-	16.	0.287	1.	ND	-	-	-	-	-
34591.	67.	68.	151.	-	-	-	ND	-	-	-	-	-
34591.	63.	-	-	48.	0.148	1.	1.	-	-	3.	1.767	1.
34591.	26.	26.	146.	-	-	-	ND	-	-	-	-	-
34591.	35.	-	-	37.	0.077	1.	ND	-	-	-	-	-
34591.	39.	82.	47.	-	-	-	ND	50.	59.	-	-	-
34591.	40.	-	-	41.	0.034	1.	ND	-	-	-	-	-
34591.	41.	80	72.	-	-	-	ND	30.	67.	-	-	-
34591.	70.		-	60.	0.216	1.	ND	-	-	-	-	-
34591.	46.	100.	41.	-	-	-	ND	40.	72.	-	-	-
34591.	57.	159.	92.	-	-	-	ND	60.	57.	-	-	-
34591.	44.	-	-	45.	0.019	1.	ND	-	-	-	-	-
34591.	56.	153.	26.	-	-	-	ND	30.	63.	-	-	-
34591.	25.	-	-	23.	0.110	1.	ND	-	-	-	-	-
34591.	44.	100.	72.	-	-	-	ND	50.	58.	-	-	-
34591.	49.	-	-	25.	0.938	1.	ND	-	-	-	-	-
34591.	33.	86.	10.	-	-	-	ND	30.	64.	-	-	-
34591.	44.	90.	82.	-	-	-	ND	10.	76.	-	-	-
34591.	49.	-	-	50.	0.024	1.	ND	-	-	-	-	-
34591.	29.	61.	61.	-	-	-	ND	70.	38.	-	-	-
34591.	39.	79.	53.	-	-	-	ND	60.	62.	-	-	-
34591.	43.	-	-	37.	0.218	1.	ND	-	-	-	-	-
34591.	58.	-	-	60.	0.038	1.	ND	-	-	-	-	-
34591.	57.	99.	18.		-	-	ND	50.	37.	-	-	-
34591.	71.	-	-	68.	0.056	1.	ND	-	-	-	-	-
34591.	45.	89.	25.	-	-	-	ND	40.	67.	-	-	-
34591.	52.	160.	52.	-	-	-	ND	35.	25.	-	-	-
34591.	65.	-	-	59.	0.142	1.	ND	-	-	-	-	-
34591.	135.	301.	-39.	-	-	-	ND	30.	29.	-	-	-
34591.	61.	100.	89.	-	-	-	ND	40.	37.	-	-	-
34591.	46.	-	-	47.	0.024	1.	ND	-	-	-	-	-
34591.	28.	100.	42.	-	-	-	ND	56.	94.	-	-	-
34591.	60.	124.	36.	-	-	-	ND	50.	34.	-	-	-
34591.	48.	-	-	48.	0.000	1.	ND	-	-	-	-	-
34591.	ND	-	-	-	-	-	ND	20.	91.	-	-	-
34591.	ND	-	-	-	-	-	15.	15.	167.	-	-	-
34591.	ND	-	-	-	-	-	5.	5.	160.	-	-	-
34591.	5.	5.	0.	-	-	-	ND	-	-	-	-	-
34591.	5.	2.	0.	-	-	-	ND	-	-	-	-	-
34591.	ND	-	-	-	-	-	15.	53.	113.	-	-	-
34591.	ND	-	-	-	-	-	5.	-	-	-	-	-
34646.	ND	-	-	-	-	-	ND	30.	61.	-	-	-
34646.	ND	200.	72.	-	-	-	ND	50.	59.	-	-	-
34646.	ND	150.	87.	-	-	-	ND	100.	41.	-	-	-
34646.	ND	300.	56.	-	-	-	ND	30.	114.	-	-	-
34646.	ND	120.	93.	-	-	-	ND	50.	38.	-	-	-
34646.	ND	200.	59.	-	-	-	ND	100.	47.	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34646.	ND	150.	58.	-	-	-	ND	100.	69.	-	-	-
34646.	ND	100.	68.	-	-	-	ND	200.	57.	-	-	-
34646.	ND	200.	59.	-	-	-	ND	50.	83.	-	-	-
34646.	ND	100.	85.	-	-	-	ND	80.	80.	-	-	-
34646.	ND	80.	94.	-	-	-	ND	125.	60.	-	-	-
34646.	ND	125.	56.	-	-	-	ND	150.	56.	-	-	-
34646.	ND	175.	56.	-	-	-	ND	150.	64.	-	-	-
34646.	ND	160.	69.	-	-	-	ND	100.	49.	-	-	-
34646.	ND	200.	52.	-	-	-	ND	130.	43.	-	-	-
34646.	ND	150.	127.	-	-	-	ND	150.	46.	-	-	-
34646.	ND	100.	63.	-	-	-	ND	120.	68.	-	-	-
34646.	ND	200.	56.	-	-	-	ND	175.	48.	-	-	-
39094.	5.	-	-	-	-	-	ND	-	-	-	-	-
39094.	5.	-	-	-	-	-	1.	-	-	2.	1.139	1.
39094.	ND	-	-	-	-	-	5.	-	-	2.	1.138	1.
39094.	37.	37.	124.	-	-	-	24.	24.	125.	-	-	-
39094.	5.	4.	0.	-	-	-	11.	10.	30.	-	-	-
39094.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
39094.	ND	-	-	-	-	-	5.	5.	0.	-	-	-
39094.	ND	-	-	-	-	-	5.	-	-	5.	0.000	1.
39094.	ND	-	-	-	-	-	13.	10.	60.	-	-	-
39094.	12.	-	-	12.	0.000	1.	5.	-	-	5.	0.000	1.
39094.	ND	-	-	-	-	-	33.	55.	115.	-	-	-
39094.	ND	-	-	-	-	-	10.	56.	109.	-	-	-
39094.	ND	-	-	-	-	-	1.	-	-	2.	1.139	1.
39094.	ND	-	-	-	-	-	9.	55.	80.	-	-	-
39094.	ND	-	-	-	-	-	5.	-	-	7.	0.491	1.
39094.	ND	-	-	-	-	-	13.	-	-	8.	0.676	1.
39094.	ND	-	-	-	-	-	10.	5.	60.	-	-	-
39094.	340.	340.	50.	-	-	-	220.	220.	164.	-	-	-
39094.	340.	330.	194.	-	-	-	500.	520.	96.	-	-	-
39094.	360.	-	-	360.	0.000	1.	490.	-	-	485.	0.015	1.
39094.	350.	360.	22.	-	-	-	380.	380.	26.	-	-	-
39094.	170.	-	-	189.	0.149	1.	220.	-	-	220.	0.000	1.
39094.	130.	140.	143.	-	-	-	96.	110.	122.	-	-	-
39094.	210.	-	-	210.	0.000	1.	110.	-	-	110.	0.000	1.
39094.	360.	-	-	375.	0.067	1.	460.	322.	87.	455.	0.016	1.
39094.	230.	-	-	245.	0.087	1.	280.	339.	124.	248.	0.171	1.
39094.	490.	-	-	470.	0.030	1.	720.	339.	62.	700.	0.040	1.
39094.	390.	-	-	385.	0.018	1.	350.	347.	101.	355.	0.020	1.
39094.	320.	-	-	271.	0.233	1.	390.	312.	93.	385.	0.018	1.
39094.	300.	-	-	315.	0.067	1.	440.	-	-	349.	0.167	3.
39094.	720.	-	-	629.	0.190	1.	240.	-	-	281.	0.114	3.
39094.	755.	1250.	81.	-	-	-	194.	1500.	105.	-	-	-
39094.	487.	1250.	120.	-	-	-	200.	1000.	114.	-	-	-
39094.	402.	-	-	292.	0.462	1.	173.	-	-	201.	0.214	1.
39094.	289.	2500.	111.	-	-	-	195.	200.	69.	-	-	-
39094.	509.	-	-	470.	0.113	1.	239.	-	-	196.	0.284	1.
39094.	759.	813.	34.	-	-	-	172.	175.	63.	-	-	-
39094.	550.	563.	74.	-	-	-	132.	156.	78.	-	-	-
39094.	471.	500.	79.	-	-	-	144.	156.	87.	-	-	-
39094.	404.	-	-	399.	0.016	1.	202.	-	-	203.	0.010	1.
39094.	276.	312.	117.	-	-	-	298.	312.	80.	-	-	-
39094.	357.	-	-	330.	0.111	1.	279.	-	-	287.	0.042	1.
39094.	247.	250.	92.	-	-	-	215.	250.	225.	-	-	-
39094.	ND	-	-	-	-	-	221.	250.	298.	-	-	-
39094.	295.	-	-	268.	0.134	1.	505.	-	-	472.	0.094	1.
39094.	224.	312.	92.	-	-	-	232.	625.	64.	-	-	-
39094.	403.	-	-	405.	0.009	1.	204.	-	-	197.	0.050	1.
39094.	287.	375.	86.	-	-	-	247.	312.	82.	-	-	-
39094.	319.	-	-	284.	0.167	1.	180.	-	-	181.	0.004	1.
39094.	285.	375.	40.	-	-	-	389.	500.	66.	-	-	-
39094.	277.	375.	99.	-	-	-	324.	438.	120.	-	-	-
39094.	407.	-	-	371.	0.131	1.	135.	-	-	196.	0.531	1.
39094.	567.	250.	87.	-	-	-	318.	375.	84.	-	-	-
39094.	178.	-	-	211.	0.240	1.	317.	-	-	319.	0.009	1.
39094.	578.	750.	102.	-	-	-	253.	313.	102.	-	-	-
39094.	649.	813.	105.	-	-	-	200.	500.	86.	-	-	-
39094.	357.	500.	37.	-	-	-	171.	375.	64.	-	-	-
39094.	455.	-	-	472.	0.051	1.	195.	-	-	196.	0.004	1.
39094.	184.	500.	54.	-	-	-	238.	313.	43.	-	-	-
39094.	219.	-	-	226.	0.044	1.	206.	-	-	200.	0.042	1.
39094.	151.	-	-	147.	0.034	1.	104.	-	-	97.	0.160	1.
34694.	1200.	1200.	317.	-	-	-	34.	-	-	13.	1.356	1.
34694.	1400.	1400.	36.	-	-	-	5.	-	-	5.	0.000	1.
34694.	670.	-	-	665.	0.011	1.	ND	-	-	-	-	-
34694.	2800.	-	-	1833.	0.599	1.	5.	-	-	7.	0.491	1.
34694.	3200.	-	-	2263.	0.490	1.	5.	-	-	5.	0.000	1.
34694.	3200.	5201.	27.	-	-	-	5.	-	-	5.	0.000	1.
34694.	730.	-	-	936.	0.351	1.	5.	-	-	5.	0.000	1.
34694.	990.	-	-	-	-	-	ND	107.	25.	-	-	-
34694.	670.	-	-	-	-	-	ND	-	-	-	-	-

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34694.	1470.					-	ND					-
34694.	23.	24.	46.	-	-	-	ND	-	-	-	-	-
34694.	13.	13.	269.	-	-	-	5.	-	-	2.	1.138	1.
34694.	26.	-	-	26.	0.027	1.	ND	-	-	-	-	-
34694.	54.	54.	511.	-	-	-	5.	-	-	2.	1.138	1.
34694.	48.	-	-	57.	0.246	1.	ND	-	-	-	-	-
34694.	21.	20.	20.	-	-	-	ND	-	-	-	-	-
34694.	61.	-	-	49.	0.315	1.	ND	-	-	-	-	-
34694.	5.	30.	154.	-	-	-	ND	50.	47.		-	-
34694.	5.	-	-	5.	0.000	1.	ND	-	-	-	-	-
34694.	5.	20.	127.	-	-	-	ND	30.	39.	-	-	-
34694.	32.	-	-	25.	0.340	1.	ND	-	-	-	-	-
34694.	5.	19.	72.	-	-	-	ND	40.	44.	-	-	-
34694.	19.	51.	29.	-	-	-	ND	60.	34.	-	-	-
34694.	10.	-	-	7.	0.505	1.	ND	-	-	-	-	-
34694.	11.	30.	252.	-	-	-	ND	20.	45.	-	-	-
34694.	14.	-	-	15.	0.054	1.	ND	-	-	-	-	-
34694.	24.	50.	127.	-	-	-	ND	50.	53.	-	-	-
34694.	12.	-	-	18.	0.609	1.	ND	-	-	-	-	-
34694.	13.	20.	41.	-	-	-	ND	30.	62.	-	-	-
34694.	33.	60.	69.	-	-	-	5.	15.	0.	-	-	-
34694.	12.	-	-	8.	0.633	1.	ND	-	-	-	-	-
34694.	29.	60.	65.	-	-	-	ND	20.	57.	-	-	-
34694.	19.	40.	97.	-	-	-	ND	50.	48.	-	-	-
34694.	41.	-	-	37.	0.154	1.	ND	-	-	-	-	-
34694.	25.	-	-	27.	0.115	1.	ND	-	-	-	-	-
34694.	24.	51.	59.	-	-	-	ND	50.	50.	-	-	-
34694.	22.	-	-	22.	0.026	1.	ND	-	-	-	-	-
34694.	27.	50.	44.	-	-	-	ND	40.	63.	-	-	-
34694.	19.	39.	54.	-	-	-	ND	35.	58.	-	-	-
34694.	17.	-	-	17.	0.008	1.	ND	-	-	-	-	-
34694.	32.	60.	-29.	-	-	-	ND	30.	58.	-	-	-
34694.	36.	99.	69.	-	-	-	ND	40.	58.	-	-	-
34694.	26.	-	-	26.	0.000	1.	ND	-	-	-	-	-
34694.	18.	50.	44.	-	-	-	ND	56.	63.	-	-	-
34694.	21.	39.	38.	-	-	-	ND	50.	51.	-	-	-
34694.	13.	-	-	13.	0.048	1.	ND	-	-	-	-	-
34694.	ND	-	-	-	-	-	ND	20.	56.	-	-	-
34694.	130.	130.	169.	-	-	-	ND	-	-	-	-	-
34694.	330.	300.	93.	-	-	-	5.	1.	0.	-	-	-
34694.	120.	-	-	130.	0.109	1.	5.	-	-	5.	0.000	1.
34694.	40.	40.	25.	-	-	-	14.	15.	33.	-	-	-
34694.	680.	-	-	680.	0.000	1.	5.	-	-	5.	0.000	1.
34694.	63.	60.	62.	-	-	-	5.	8.	63.	-	-	-
34694.	180.	-	-	180.	0.000	1.	5.	-	-	5.	0.000	1.
34694.	117.	58.	109.	-	-	-	5.	-	-	-	-	-
34694.	202.	580.	38.	-	-	-	ND	-	-	-	-	-
34694.	84.	-	-	89.	0.087	1.	ND	-	-	-	-	-
34694.	114.	291.	47.	-	-	-	19.	58.	29.	-	-	-
34694.	421.	-	-	432.	0.036	1.	8.	-	-	8.	0.676	1.
34694.	59.	258.	112.	-	-	-	5.	-	-	2.	1.138	1.
34694.	72.	-	-	89.	0.306	1.	5.	-	-	-	-	-
34694.	33.	-	-	-	-	-	ND	-	-	-	-	-
34694.	57.	-	-	62.	0.114	1.	5.	-	-	5.	0.000	1.
34694.	170.	100.	-10.	-	-	-	ND	20.	0.	-	-	-
34694.	32.	-	-	34.	0.083	1.	5.	-	-	5.	0.000	1.
34694.	126.	-	-	-	-	-	5.	20.	0.	-	-	-
34694.	49.	50.	40.			-	ND	20.	0.	-	-	-
34694.	180.	-	-	147.	0.207	1.	5.	-	-	5.	0.000	1.
34694.	89.	50.	38.	-	-	-	ND	30.	43.	-	-	-
34694.	130.	-	-	147.	0.177	1.	5.	-	-	7.	0.557	1.
34694.	220.	-	-	-	-	-	ND	50.	42.	-	-	-
34694.	210.	-	-	233.	0.178	1.	5.	-	-	5.	0.000	1.
34694.	235.	100.	50.	-	-	-	ND	50.	30.	-	-	-
34694.	370.	100.	-50.	-	-	-	ND	50.	38.	-	-	-
34694.	480.	-	-	427.	0.165	1.	ND	-	-	-	-	-
34694.	78.	-	-	-	-	-	ND	-	-	-	-	-
34694.	110.	100.	-2.	-	-	-	ND	50.	100.	-	-	-
34694.	94.	-	-	54.	0.784	1.	ND	-	-	-	-	-
34694.	36.	100.	20.	-	-	-	ND	50.	74.	-	-	-
34694.	28.	-	-	-	-	-	ND	-	-	-	-	-
34694.	160.	-	-	-	-	-	ND	50.	34.	-	-	-
34694.	20.	-	-	22.	0.129	1.	ND	-	-	-	-	-
34694.	860.	100.	-247.	-	-	-	ND	50.	22.	-	-	-
34694.	720.	100.	25.	-	-	-	ND	50.	62.	-	-	-
34694.	344.	-	-	380.	0.141	1.	ND	-	-	-	-	-
34694.	46.	100.	69.	-	-	-	ND	50.	12.	-	-	-
34694.	330.	100.	-22.	-	-	-	ND	50.	18.	-	-	-
34694.	217.	-	-	256.	0.236	1.	ND	-	-	-	-	-
34694.	280.	100.	110.	-	-	-	ND	50.	16.	-	-	-
34694.	40.	-	-	39.	0.036	1.	ND	-	-	-	-	-
34694.	34.	-	-	36.	0.097	1.	5.	-	-	2.	1.138	1.

	Influent						Effluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34694.	450.	100.	210.	-	-	-	ND	50.	62.	-	-	-
34694.	370.	-	-	316.	0.223	1.	ND	-		-		-
34694.	1040.	100.	10.		-		ND	50.	26.			-
34694.	245.	-	-	221.	0.143	1.	ND	-	-	-	-	-
34694.	740.	780.	-4.	-	-	-	ND	-	-	-	-	-
34694.	20.	20.	-45.	-	-	-	ND	-	-	-	-	-
34694.	1300.	-	-	1196.	0.118	1.	ND	-	-	-	-	-
34694.	260.	260.	-31.	-	-	-	ND	-	-	-	-	-
34694.	710.	-	-	642.	0.143	1.	ND	-	-	-	-	-
34694.	940.	960.	-17.	-	-	-	ND	-	-	-	-	-
34694.	720.	-	-	735.	0.029	1.	ND	-	-	-	-	-
34694.	4300.	-	-	4300.	0.000	1.	ND	60.	88.	-	-	-
34694.	3200.	-	-	3046.	0.070	1.	ND	58.	115.	-	-	-
34694.	1800.	-	-	1697.	0.083	1.	ND	6.	217.	-	-	-
34694.	2700.	-	-	2939.	0.120	1.	ND	6.	50.	-	-	-
34694.	1300.	-	-	1082.	0.260	1.	ND	5.	160.	-	-	-
34694.	2300.	-	-	2145.	0.099	1.	ND	-	-	-	-	-
34694.	4400.	-	-	4299.	0.033	1.	ND	-	-	-	-	-
34694.	2230.	2500.	116.	-	-	-	19.	251.	35.	-	-	-
34694.	1370.	1250.	77.	-	-	-	14.	94.	63.	-	-	-
34694.	2359.	-	-	2375.	0.010	1.	24.	-	-	19.	0.347	1.
34694.	1890.	2500.	101.	-	-	-	5.	75.	56.	-	-	-
34694.	3523.	-	-	3415.	0.044	1.	24.	-	-	32.	0.427	1.
34694.	2083.	2500.	57.	-	-	-	31.	311.	43.	-	-	-
34694.	2070.	2500.	51.	-	-	-	21.	437.	56.	-	-	-
34694.	840.	875.	103.	-	-	-	14.	156.	33.	-	-	-
34694.	808.	-	-	848.	0.068	1.	5.	-	-	5.	0.000	1.
34694.	854.	875.	67.	-	-	-	12.	124.	59.	-	-	-
34694.	609.	-	-	530.	0.195	1.	15.	-	-	8.	0.005	1.
34694.	633.	625.	102.	-	-	-	33.	311.	61.	-	-	-
34694.	ND	-	-	-	-	-	5.	62.	102.	-	-	-
34694.	1276.	-	-	1283.	0.008	1.	5.	-	-	5.	0.000	1.
34694.	601.	750.	78.	-	-	-	ND	125.	62.	-	-	-
34694.	2653.	-	-	2492.	0.089	1.	5.	-	-	5.	0.000	1.
34694.	1097.	1250.	94.	-	-	-	5.	124.	43.	-	-	-
34694.	1133.	-	-	1139.	0.008	1.	5.	-	-	5.	0.000	1.
34694.	1280.	1250.	101.	-	-	-	20.	125.	120.	-	-	-
34694.	1234.	1250.	116.	-	-	-	36.	438.	89.	-	-	-
34694.	1033.	-	-	1062.	0.039	1.	38.	-	-	38.	0.013	1.
34694.	1326.	1250.	77.	-	-	-	17.	250.	86.	-	-	-
34694.	879.	-	-	688.	0.347	1.	16.	-	-	17.	0.103	1.
34694.	57.	750.	100.	-	-	-	ND	250.	102.	-	-	-
34694.	1070.	2500.	87.	-	-	-	13.	249.	80.	-	-	-
34694.	1590.	1000.	48.	-	-	-	35.	126.	19.	-	-	-
34694.	1381.	-	-	1433.	0.052	1.	24.	-	-	20.	0.269	1.
34694.	2240.	2500.	86.	-	-	-	31.	125.	91.	-	-	-
34694.	522.	-	-	518.	0.010	1.	20.	-	-	20.	0.021	1.
34694.	26.	-	-	26.	0.000	1.	906.	-	-	856.	0.001	1.
34621.	ND	-	-	-	-	-	ND	104.	34.	-	-	-
34621.	ND	-	-	-	-	-	ND	104.	63.	-	-	-
34621.	240.	240.	21.	-	-	-	16.	16.	-13.	-	-	-
34621.	57.	-	-	-	-	-	14.	15.	53.	-	-	-
34621.	100.	-	-	100.	0.000	1.	110.	-	-	110.	0.000	1.
34621.	80.	80.	3.	-	-	-	39.	-	-	-	-	-
34621.	49.	-	-	48.	0.029	1.	ND	-	-	-	-	-
34621.	64.	60.	77.	-	-	-	13.	-	-	-	-	-
34621.	130.	-	-	125.	0.057	1.	14.	-	-	18.	0.320	1.
34621.	171.	50.	78.	-	-	-	17.	50.	110.	-	-	-
34621.	36.	250.	93.	-	-	-	5.	-	-	-	-	-
34621.	68.	-	-	71.	0.060	1.	56.	-	-	52.	0.094	1.
34621.	62.	100.	89.	-	-	-	46.	50.	90.	-	-	-
34621.	37.	-	-	35.	0.060	1.	ND	-	-	-	-	-
34621.	45.	100.	111.	-	-	-	20.	-	-	21.	0.067	1.
34621.	107.	-	-	113.	0.081	1.	19.	5.	100.	-	-	-
34621.	27.	-	-	-	-	-	ND	-	-	-	-	-
34621.	5.	-	-	5.	0.000	1.	57.	-	-	50.	0.199	1.
34621.	10.	100.	3.	-	-	-	ND	20.	10.	-	-	-
34621.	5.	-	-	8.	0.619	1.	24.	-	-	5.	2.247	1.
34621.	21.	-	-	-	-	-	79.	20.	-330.	-	-	-
34621.	16.	50.	54.	-	-	-	ND	20.	0.	-	-	-
34621.	68.	-	-	51.	0.393	1.	ND	-	-	-	-	-
34621.	60.	50.	52.	-	-	-	22.	30.	70.	-	-	-
34621.	39.	-	-	45.	0.19[illegible]	1.	11.	-	-	13.	0.265	1.
34621.	23.	-	-	-	-	-	ND	50.	90.	-	-	-
34621.	49.	-	-	46.	0.092	1.	ND	-	-	-	-	-
34621.	68.	100.	50.	-	-	-	ND	50.	152.	-	-	-
34621.	180.	100.	-10.	-	-	-	15.	50.	64.	-	-	-
34621.	38.	-	-	34.	0.167	1.	36.	-	-	36.	0.000	1.
34621.	23.	-	-	-	-	-	48.	50.	16.	-	-	-
34621.	57.	100.	84.	-	-	-	21.	50.	-8.	-	-	-
34621.	18.	-	-	4.	2.044	1.	11.	-	-	7.	0.557	1.
34621.	24.	100.	57.	-	-	-	75.	50.	-140.	-	-	-

	Influent						EFfluent					
	C	S	R	M	SD	N	C	S	R	M	SD	N
34621.	83.	-	-	47.	0.794	1.	62.	-	-	18.	1.700	1.
34621.	20.	-	-	-	-	-	5.	50.	20.	-	-	-
34621.	48.	-	-	57.	0.246	1.	5.	-	-	5.	0.000	1.
34621.	49.	100.	31.	-	-	-	ND	50.	56.	-	-	-
34621.	41.	100.	67.	-	-	-	5.	50.	78.	-	-	-
34621.	28.	-	-	34.	0.270	1.	ND	-	-	-	-	-
34621.	44.	100.	61.	-	-	-	ND	50.	0.	-	-	-
34621.	61.	100.	44.	-	-	-	ND	50.	16.	-	-	-
34621.	76.	-		44.	0.758	1.	5.	-	-	7.	1.118	1.
34621.	103.	100.	104.			-	5.	50.	18.			
34621.	44.	-	-	41.	0.088	1.	ND	-	-	-		-
34621.	12.	-	-	13.	0.109	1.	ND	-	-	-	-	-
34621.	280.	100.	200.	-	-	-	ND	50.	360.	-	-	-
34621.	50.	-	-	44.	0.194	1.	10.	-	-	10.	0.000	1.
34621.	30.	100.	90.	-	-	-	ND	50.	38.	-	-	-
34621.	20.	-	-	14.	0.490	1.	11.	-	-	3.	1.696	1.
34621.	120.	110.	0.	-	-	-	87.	70.	61.	-	-	-
34621.	200.	200.	140.	-	-	-	31.	30.	50.	-	-	-
34621.	640.	-	-	593.	0.107	1.	580.	-	-	590.	0.024	1.
34621.	340.	340.	65.	-	-	-	88.	90.	58.	-	-	-
34621.	160.	-		160.	0.094	1.	27.	-	-	27.	0.026	1.
34621.	130.	140.	93.	-	-	-	48.	50.	104.	-	-	-
34621.	100.	-	-	100.	0.000	1.	74.	-	-	71.	0.060	1.
34621.	60.	-	-	66.	0.139	1.	130.	43.	93.	135.	0.052	1.
34621.	130.	-	-	128.	0.057	1.	ND	60.	77.	-	-	-
34621.	97.	-	-	94.	0.046	1.	12.	59.	107.	12.	0.000	1.
34621.	440.	-	-	460.	0.062	1.	350.	73.	41.	335.	0.063	1.
34621.	97.	-	-	98.	0.022	1.	120.	49.	82.	110.	0.129	1.
34621.	120.	-	-	128.	0.057	1.	31.	-	-	27.	0.139	3.
34621.	78.	-	-	71.	0.129	1.	72.	-	-	82.	0.146	3.
34621.	186.	375.	109.	-	-	-	105.	750.	89.	-	-	-
34621.	156.	250.	110.	-	-	-	103.	750.	103.	-	-	-
34621.	120.	-	-	109.	0.139	1.	172.	-	-	137.	0.323	1.
34621.	90.	125.	141.	-	-	-	101.	500.	100.	-	-	-
34621.	671.	-	-	368.	0.849	1.	223.	-	-	142.	0.641	1.
34621.	266.	312.	117.	-	-	-	112.	562.	81.	-	-	-
34621.	209.	250.	101.	-	-	-	55.	375.	83.	-	-	-
34621.	173.	312.	131.	-	-	-	61.	312.	73.	-	-	-
34621.	355.	-	-	330.	0.104	1.	59.	-	-	63.	0.104	1.
34621.	158.	188.	92.	-	-	-	104.	500.	76.	-	-	-
34621.	1169.	-	-	1032.	0.176	1.	113.	-	-	106.	0.092	1.
34621.	ND	-	-	-	-	-	273.	312.	216.	-	-	-
34621.	483.	-	-	521.	0.106	1.	537.	-	-	527.	0.027	1.
34621.	572.	1000.	40.	-	-	-	207.	500.	60.	-	-	-
34621.	772.	-	-	654.	0.235	1.	137.	-	-	138.	0.010	1.
34621.	744.	1250.	42.	-	-	-	162.	250.	66.	-	-	-
34621.	501.	-	-	471.	0.089	1.	111.	-	-	112.	0.019	1.
34621.	616.	750.	114.	-	-	-	271.	375.	93.	-	-	-
34621.	583.	750.	108.	-	-	-	157.	625.	124.	-	-	-
34621.	333.	-	-	309.	0.105	1.	145.	-	-	151.	0.061	1.
34621.	561.	750.	138.	-	-	-	91.	500.	98.	-	-	-
34621.	216.	-	-	199.	0.117	1.	106.	-	-	104.	0.020	1.
34621.	732.	875.	123.	-	-	-	96.	375.	88.	-	-	-
34621.	408.	-	-	-	-	-	359.	500.	216.	-	-	-
34621.	643.	-	-	528.	0.280	1.	156.	-	-	150.	0.052	1.
34621.	408.	625.	20.	-	-	-	224.	313.	127.	-	-	-
34621.	217.	-	-	223.	0.073	1.	199.		-	204.	0.038	1.
34621.	156.	-		156.	0.014	1.	240.	-	-	251.	0.065	1.